

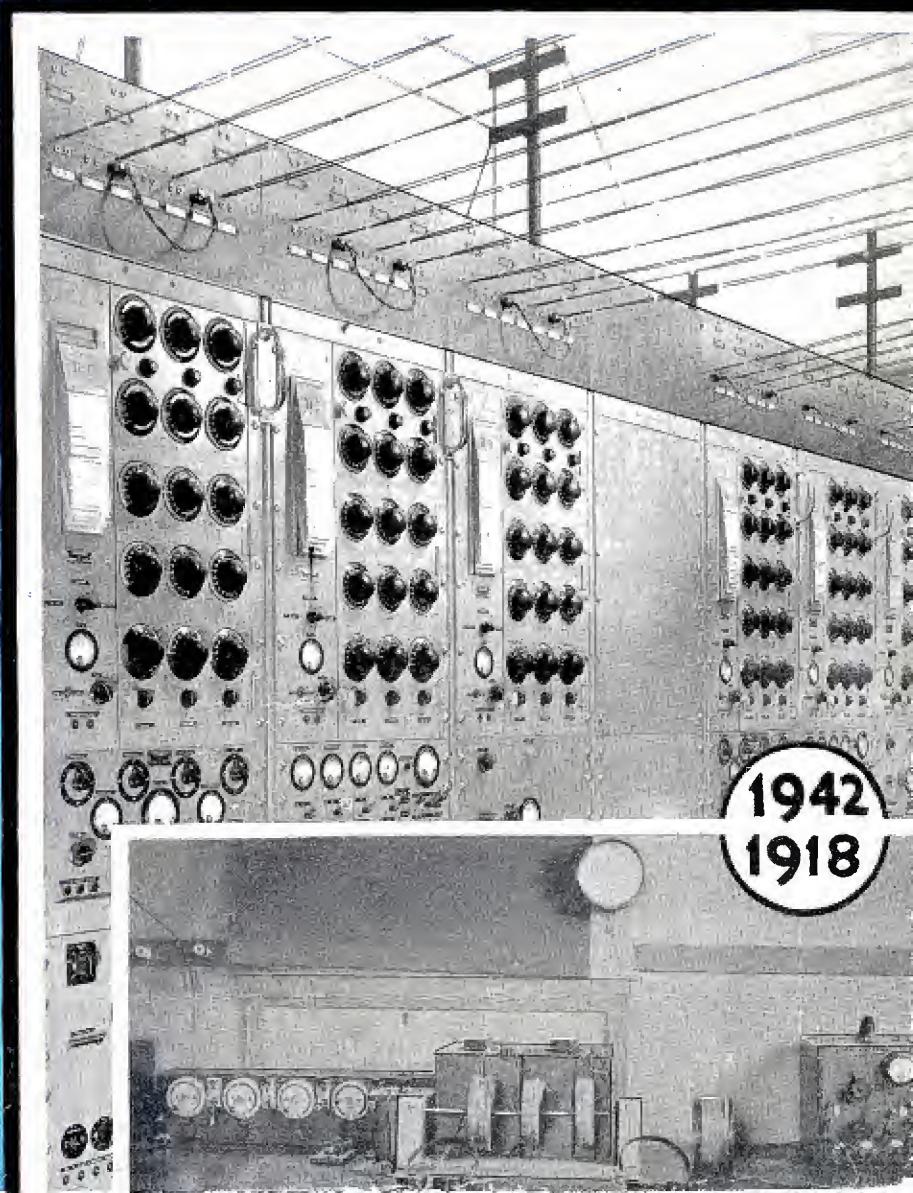
# COMMUNICATIONS

F-M PROGRESS TESTS

COASTAL RADIO-TELEPHONE  
SYSTEMS

CIVIL DEFENSE  
NETWORKS

FEBRUARY  
1942



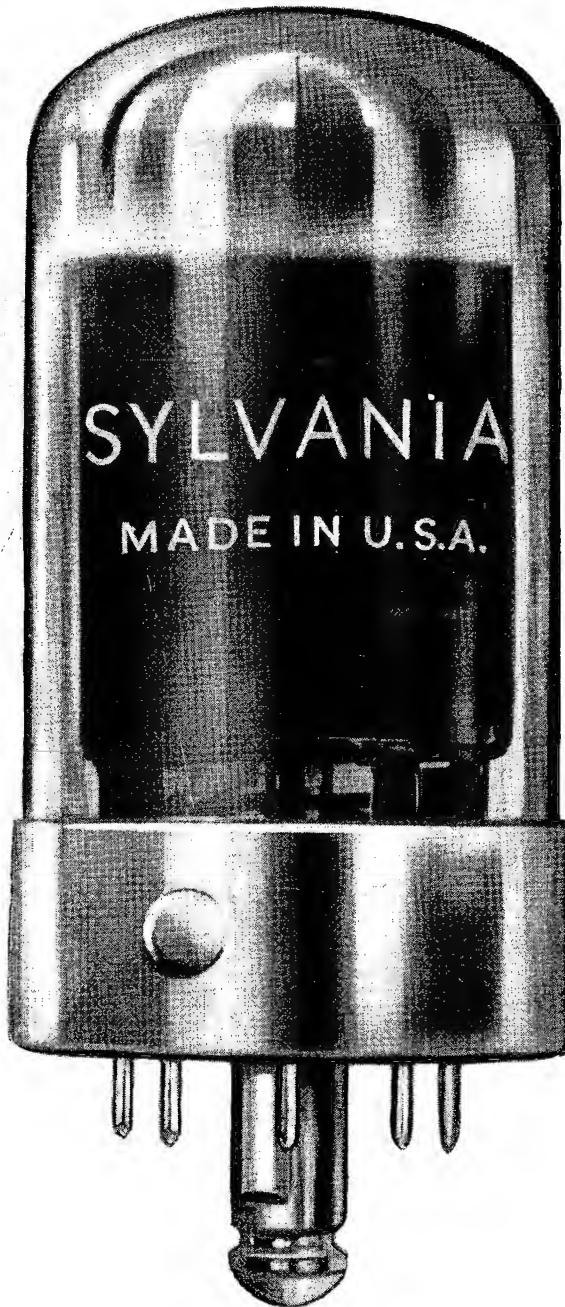
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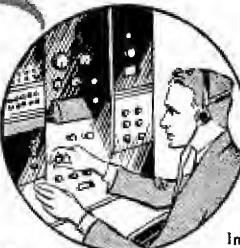


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FEBRUARY, 1942

VOLUME 22 NUMBER 2

## We See...

WITH CONVERSION AND CONSERVATION the theme of the day, development, design and methods of application will undergo a truly revolutionary change. For many, this new format will concern new equipment for the armed services with its attendant stringent requisites. For others this new order will mean complete new types of product design, and still for others, it will mean "renovation" design.

Efficiency characteristics will have to be maintained or improved upon by the use of, in many instances, ingenious circuit arrangements and by the application of components, that may be new or repaired. There will be defective components that perhaps cannot be replaced and have been thus heretofore considered a total loss. Improvisations will have to be made whereby such "losses" may be minimized. A common source of this condition prevails in the tube setups. Methods and suggestions for such repairs are already being studied and resulting data collated.

The laboratory and shop will assume a new important role in this era of emergency design and development. To maintain such a program, it will be often necessary to resort to new forms of engineering, one of which will be familiar to all of us, while the others will be new to many. In the first instance, we are referring, of course, to radio and electrical engineering, while in the second instances, we refer to chemical and metallurgical engineering. Of course it will be difficult to gain a knowledge of this latter subject overnight, but intensive research and study will go a long

(Continued on page 35)

### COVER ILLUSTRATION

Communication progress is effectively illustrated in these views of a typical 1918 (1st World War) receiving installation and the equipment used today (2d World War). The 1918 system for trans-Atlantic reception was very simple, consisting of a loop antenna, a receiver, balancing coils and a breadboard amplifier, with a suitable static reducing system. Today's installation (RCA equipment shown) uses multi-tube diversity receivers with triple detection methods, variety of antennae and associated receiving improvements to assure an amazing consistency and efficiency of performance imperative today.

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Once again we are on such a detour: in a war we did not seek, and which our enemies will one day regret seeking. Once again we have deferred our peaceful progress and have dedicated every effort to getting *through* that detour. And once

again—when we are through—we shall turn our eyes towards greater horizons . . . towards new achievements through science and industry—new things for a new and greater America.

Here at RCA, this is our creed . . . and we fear neither today nor tomorrow. We know that when this war is won, radio has many contributions to make to our way of life. New techniques of broadcasting. Television. New applications of radio science to industrial production. Facsimile . . . the list is endless.

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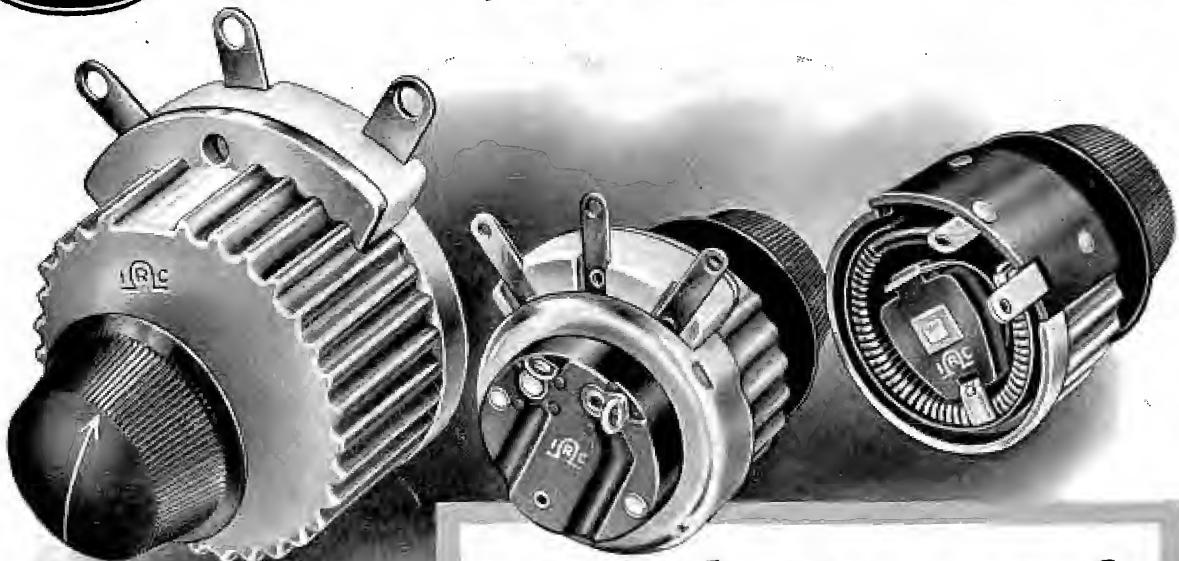
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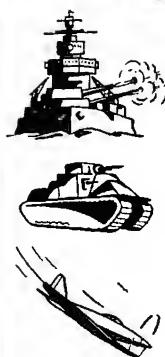


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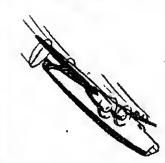
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# COMMUNICATIONS

LEWIS WINNER, Editor

## *The Tests that Proved* **F-M VITAL TO COMMUNICATIONS**

by HERBERT DuVAL, Jr.

Radio and Television Department  
General Electric Company

**F**REQUENCY modulation has been a major contribution to the "short-haul" communication system. The large number of frequency modulation communication systems which have been installed in less than two years since commercial apparatus became available is evidence of the widespread interest in this communication principle. This ready acceptance has been gratifying to engineers who developed the system.

In 1934, with the installation of two-way u-h-f radio equipment for the Boston (Mass.) Police Department, the use of frequencies between 30 and 40 mega-



A G.E. control unit, with provision for remote operation with a remote control unit.

cycles for local communication purposes was on the rise. A few years later the public utilities began using these frequencies for communication with their truck and emergency repair crews.

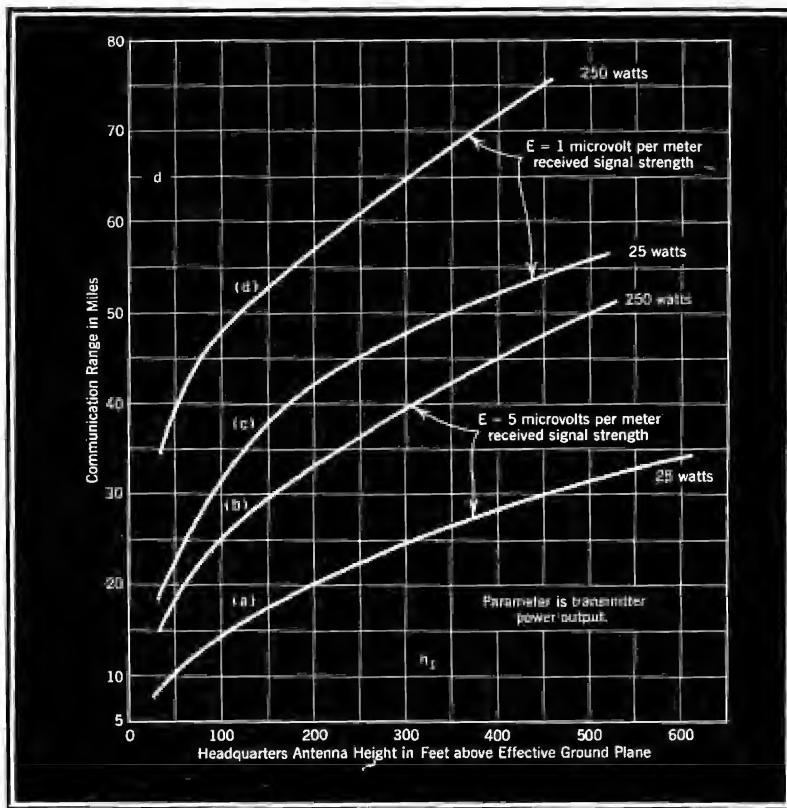
Many of these communication systems did not cover the entire area over which

communication was desired. The practical limitation of power (15 watts) in the mobile transmitter made it necessary in many systems to use pick-up receivers and bring the audio signal back to a central location on leased telephone lines. Such systems are expensive to maintain due to the telephone line rental. (Frequency modulation does not eliminate the occasional need of pick-up receivers but it does reduce the number of communication systems requiring them, and in many instances reduces the number of pick-up receivers required.)

Our engineers spent several years making thorough mathematical analyses, making laboratory and field tests, and considering standards of operation before entering into the design of commercial f-m apparatus. This long background of experience enabled us and others to bring out commercial designs superior in electrical performance, op-



At left, a 25 watt, 30 to 40 mc f-m unit with the transmitter at the left and the receiver at the right in an auto trunk compartment. At right, Dr. R. E. Bodet, senior surgical officer in charge of the quarantine station in Boston, talking to a tug via a two-way f-m hookup.



Characteristic communication range results on an f-m test between headquarters and a mobile unit operating on 30 to 40 megacycles.

eration, and mechanical construction to previous amplitude modulated apparatus.

While the idea of using f-m is almost as old as radio itself, it was Major Edward H. Armstrong's idea of wide-swing and receiver limiters (announced in 1935) that started engineers working anew and with increased tempo on the problem. From 1935 on, numerous laboratory tests were conducted. The system proved of such value that reasonably complete apparatus was constructed and field tests were begun.

The publicity given to f-m during this development period led to a large amount of interest in the police radio field. Several police agencies contacted the FCC, wondering if they would accept applications for construction permits for the use of f-m in the thirty to forty mc band.

At about this time our engineers approached the FCC with the same question, whereupon the Commission expressed a desire to witness a field demonstration of f-m police radio. There were certain aspects of related problems, the solutions to which they wished to see demonstrated. Experimental licenses might be issued to various police agencies and public utilities if the prob-

lems were solved, the Commission explained.

The problems presented to our engineers were:

(1) To prove that f-m could be used on the 40 kc channels already established between 30 and 40 megacycles.

(2) To prove that f-m had definite advantages over a-m apparatus already in use in this band.

(3) To prove that a transmitter using f-m did not give appreciably more interference to an existing a-m station on the same frequency than would a similarly powered station.

(4) To prove point 3 on the first adjacent channel.

(5) To prove point 3 on the second adjacent channel.

(6) To demonstrate acceptable standards of performance such as frequency swing, etc.

These six points meant that the apparatus used could not be just laboratory equipment, but had to be reasonably close to what would later be commercial apparatus. Fortunately we had been working on the problems and had apparatus suitable to make the demonstration. Two engineers from the FCC came to Schenectady and spent two days taking data during our field run.

The set-up was as follows: At Albany, N. Y., in the State Office Building, a 150-watt u-h-f transmitter was installed that could be either amplitude or frequency modulated. This transmitter could be adjusted to any of the three adjacent frequencies that were to be used in the tests. Changing frequency or changing from a-m to f-m did not affect the power output of the transmitter.

Vertically polarized radiation was used with a closed type J antenna on top of the building, about 390 feet above the ground level and about 610 feet above sea level.

In one of our buildings at Schenectady, N. Y. (approximately 14½ airline miles from the Albany station), was located a 50-watt amplitude modulated transmitter that was to be used on only one frequency, all frequency changing being done at Albany.

The antenna at Schenectady was also a closed J about 240 feet above ground level and approximately 465 feet above sea level.

While the ground level at Albany and Schenectady is about the same height above sea level, the ground elevation between the two points is rolling and, in one or two places, reaches elevations above sea level comparable to the height of the Schenectady antenna.

The receiver in the automobile was a superheterodyne constructed to receive either a-m or f-m, with provision to switch the receiver from plain diode detection for a-m and f-m detection by using a limiter and a discriminator. Suitable meters were connected into the receiver so that relative field strength and audio signal plus noise-to-noise ratio could be measured. The receiving antenna was the standard quarter-wave whip type vertical antenna.

Receivers were installed at Schenectady and Albany, and a mobile transmitter was installed in the car so that instructions could be given to the engineers at Schenectady and Albany while the field tests were being made.

During these tests, musical recordings were used at the Albany transmitter and voice recordings were used at Schenectady. The transmissions from each station thus could be identified easily and quickly during listening tests. Continuous tone modulation was used when measurements were being taken.

Since this apparatus was operating in the 30-40 megacycle band, and the operating channels in this band are separated by 40 kc, it was necessary to choose some operating standards that would be suitable to the FCC engineers and also later on to the communication engineer. To provide a suitable guard band, it was decided to use only 30 kc of the 40 kc channel and, hence, "100

per cent modulation" was defined as plus or minus 15 kc. Earlier tests had indicated that a five-to-one "swing ratio" between the frequency swing and the highest audio frequency produced very excellent f-m noise reduction performance. Therefore, the audio output circuit of the receiver was equipped with a filter circuit to limit the audio response to 3,000 cycles and the input level of the transmitters was adjusted to swing the output frequency plus or minus 15 kc. The input level of the tone oscillators was adjusted to provide plus or minus 15 kc swing at approximately 1,000 cycles, while the signal plus noise-to-noise ratios and adjacent channel interference measurements were taken.

The choice of the plus or minus 15 kc swing for the initial tests proved to be entirely sound, and apparatus using this standard was first licensed on an experimental basis by the FCC. All other manufacturers of f-m emergency communication equipment have adopted the same standards, and now f-m is being licensed by the FCC in the same manner as a-m apparatus has been for the past few years.

It is doubtful if f-m would have been given serious consideration by manufacturers, users, or the FCC, if it had not shown so many advantages over previously accepted standards. The improved performance provided by f-m was demonstrated by using the transmitter at Albany.

The transmitter was first amplitude modulated 100 per cent with approximately a 1,000-cycle tone and the test car proceeded directly away from the station, stopping periodically to make signal plus noise-to-noise measurements. When the car was far enough from the station so the ratio of signal-plus-noise to noise was approximately four to one, it was generally agreed that the station call letters (announced periodically in place of the tone modulation) were no longer understandable, and this was the limit of coverage by a-m transmission. The station transmitter then changed to frequency modulation and the car proceeded on until the station announcements were again unreadable. The increase in air distance from the station transmitter was approximately 50 per cent.

This test was made in several different directions from the Albany station, and in all cases the indications were that f-m provided an increased range of 50 per cent over a-m.

It is to be remembered that these tests were made with standard police type a-m receivers of the single superheterodyne type, to which had been added the i-f circuits necessary for the reception of f-m. Later design work



(Top) Desk police officer at headquarters in Maywood, Ill., using two-way f-m units. The transmitter and receiver are located in rear of the desk. (Bottom) Officer at police station in Riverside, Ill., at an f-m remote control unit, for two-way operation.

produced receivers that provide additional f-m range due to the increased sensitivity and high r-f gain. Present f-m receivers are designed with optimum sensitivity and gain to take full advantage of the ability of weaker signals to provide usable communication on f-m than was possible with a-m equipment.

Another interesting comparison of a-m and f-m was made when the output power on a-m was adjusted to 50 watts output, and signal-plus noise to noise ratio measured. The transmitter was then switched to f-m and the power reduced to approximately one watt output before a similar signal-plus-noise to noise ratio measurement was obtained. In this instance, the car remained stationary while the adjustments and measurements were made.

To determine the difference in interference between two a-m transmitters operated on the same frequency and one a-m and one f-m transmitter operated on the same frequency, the Schenectady transmitter was amplitude modulated and the mobile receiver was set for reception of a-m. The Albany transmitter was considered the interfering or undesired signal.

First, the car traveled from Schenectady to Albany, making signal-plus-noise to noise ratio measurements, while the Albany transmitter was on a-m and then the run was repeated with Albany on f-m. (f-m was the "defender," so the test was not repeated with f-m as the desired signal.)

The data taken indicated that approximately 7 db less interference was produced in an a-m receiver by an f-m carrier than by a carrier of equal strength with a-m. This reduction in interference is, of course, due to the virtual absence of a heterodyne between the a-m and f-m carriers. Hence, there would be less interference to existing a-m stations if new contemplated installations used f-m instead of a-m.

Next, the transmitter at Albany was shifted 40 kc to the next channel and the tests were repeated. Measurements indicated that the undesired f-m signal gave a slight increase in interference to the desired a-m signal as compared to equal carrier-level of undesired a-m signal. The increased interference, however, was barely discernible in the ear, and the Albany transmitter was switched back and forth between f-m and a-m.

(Continued on page 30)

# Common EMPIRICAL EQUATIONS

FORM	STRAIGHT LINE TEST
$y = mx + b$	$x$ vs. $y$
$y = a x^b$	Log $x$ vs. Log $y$
$y = B e^{ax}$	$x$ vs. Log $y$
$y = \frac{ax + b}{x}$	$x$ vs. $xy$
$y = \frac{x}{ax + b}$	$x$ vs. $\frac{x}{y}$
$y = a + Bx^2$	$x^2$ vs. $y$
$y = ax^2 + Bx + C$	$x$ vs. $\Delta y$

Figure 1  
Empirical equation summary

THE engineer often encounters related groups of data which he would like to express algebraically. The resulting equations are called empirical equations. There are many methods of determining the proper equation, but perhaps the simplest and most useful of these is the method of averages.

A general method can be adapted and is readily applicable to any of the equation forms that will be described. First, the proper form is determined. Then, numerous equations using corresponding data are formed. These are divided into a number of different groups according to the number of forms that the unknowns take.<sup>1</sup> When placing the equations into the various groups, one should place alternate equations in a given group in the case of two groups, every third equation in a given group in the case of three groups, etc.

The equations in these various groups

<sup>1</sup>i.e., two groups for  $y = mx + b$ , three groups for  $y = ax^2 + bx + c$ , etc.

\*On leave-of-absence from Research Dept. of KFI-KECA, Los Angeles, California.

An analysis of practical experience equations that will facilitate solutions to many problems of the broadcast and communications engineer

by DAWKINS ESPY\*

Research Engineer, Columbia University  
National Defense Research Laboratories

are then added, resulting in a number of equations equal to the number of constants involved. The equations thus determined are then solved simultaneously for the values of the constants, and these values are substituted back in the original form, thereby yielding the desired empirical equation. A check may be had on the accuracy of the resultant empirical equation by substituting the various values of the independent variable and calculating corresponding values of the dependent variable, and then comparing these with the actual experimental values of the dependent variable. The error in each

case may be marked plus or minus according to whether the calculated value is greater or smaller than the observed value. If the sum of the positive and negative errors are approximately equal, the points very nearly equally distributed on either side of the empirical curve, thus indicating that a satisfactory empirical equation has been evolved.

It can be easily shown that any of the equations in Figure 1 may be manipulated into the straight line form of  $y = mx + b$ . Thus, if the right notations are used for the variables a

(Continued on page 11)

X	Y <sub>obs.</sub>	n=.516 Y <sub>eq.</sub> a=30	n=.552 Y <sub>eq.</sub> a=27.5	n=.590 Y <sub>eq.</sub> a=25.2	n=.650 Y <sub>eq.</sub> a=21.8	n=.632 Y <sub>eq.</sub> a=22.6	ERROR
2	35	43	40.2	37.9	34.2	35.0	0.0
5	60	69	66.8	65	62	62.5	+2.5
10	100	98.5	98	98.2	97.3	97	-3.0
20	200	176	180	187	198.3	194.5	-5.5
50	300	255	264	280	312	300.5	+0.5
X	Y <sub>obs.</sub>	ΔY	Δ <sup>2</sup> Y	X <sup>2</sup>	Y <sub>eq.1</sub>	Y <sub>eq.2</sub>	ERROR
5	15	3	.5	25	14.982	-0.016	
10	18	3.5	.5	100	18.015	+0.015	
15	21.5	4.0	.4	225	21.531	+0.031	
20	25.5	4.4	.5	400	25.471	-0.029	
25	29.9	4.9	-	625	29.901	+0.001	
30	34.8	-	-	900	34.791	-0.009	

Figures 2 (top) and 3 (bottom).

# FM

# W51C JUMPS TO 50,000 WATTS

# FM with GL-880's



ZENITH RADIO CORPORATION  
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ZENITH FM RADIO  
6001 DICKEY AVENUE  
CHICAGO, U.S.A.

October 27, 1941

Mr. Earl Abbott  
General Electric Company  
840 South Canal Street  
Chicago, Illinois

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We are glad to say that we have been very happy with their performance, and feel that we have without doubt made the correct choice. We have found them easy to drive, easy to neutralize, and have found no cooling problems. We believe we are going to receive excellent service from them.

Yours very truly,  
ZENITH RADIO CORPORATION

G. E. Gustafson  
J. E. Brown  
ENGINEERING DEPARTMENT

JEB:BG

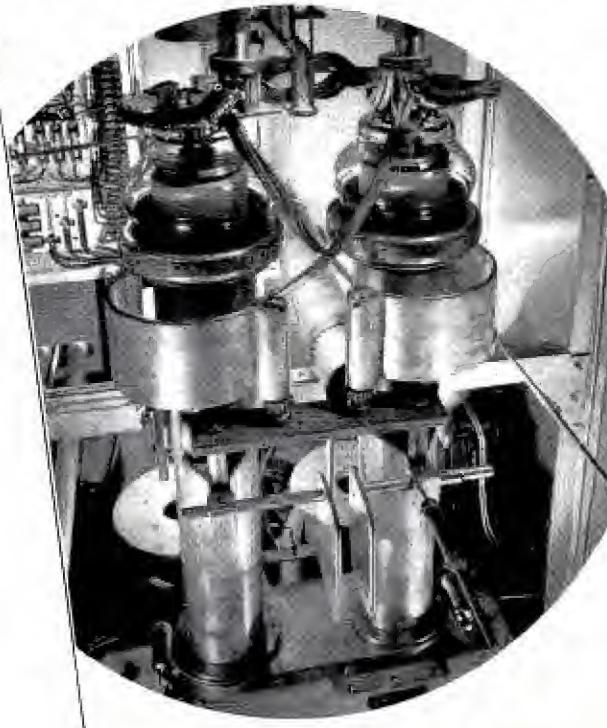
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(Left) G. E. Gustafson, Asst.  
Vice President in Charge of  
Engineering; (right) J. E.  
Brown, Executive Engineer

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Two GL-880's with only 1500 watts driving power will deliver an easy 50 kw of FM at 50 mc.

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"no cooling problems"

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Tubes

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POSITION.....  
COMPANY NAME.....  
ADDRESS.....  
NUMBER OF EMPLOYEES.....



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## EMPIRICAL EQUATIONS

(Continued from page 8)

straight line will result. For example, if we have the form:

$$y = be^{ax} \dots \dots \dots (1)$$

and we take the logarithm of both sides, we have

$$\log y = \log b + ax \log e \dots \dots \dots (2)$$

then by letting  $\log y = y'$ ,  $\log b = b'$  and  $a \log e = a'$  we have

$$y' = a'x + b' \dots \dots \dots (3)$$

the straight line form. Now we see by examination of equation (3), that if we plot  $x$  against  $y'$  or  $x$  against  $\log y$  we satisfy the straight-line law. This corresponds to the straight line test shown in Figure 1.

There is no exact rule by which one tells what form to use other than to plot the data in the various straight line tests until a straight line is found. Then one uses the corresponding form.

There are four steps in the procedure:

(1) Determine form to be used by straight line tests or knowledge of experimental data.

(2) Form equations of selected form using corresponding data, and divide equations systematically into as many groups as there are forms of the variables as explained above.

(3) Solve simultaneously equations which are the result of the addition of the groups formed in part (2), thus determining the values of the constants. These values are put back in the original form of the equation, thereby yielding the desired empirical equation.

(4) This final form may be checked for accuracy throughout the experimental range by substituting the value of one variable and determining the second variable and comparing the values with the experimental ones.

As an example, let us assume the set of experimental values as shown in

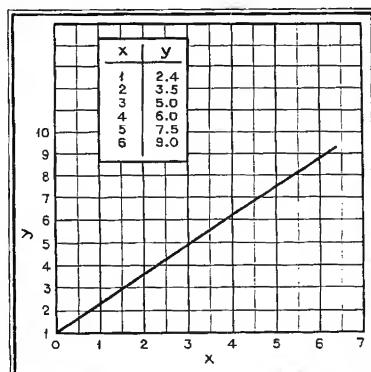


Figure 4

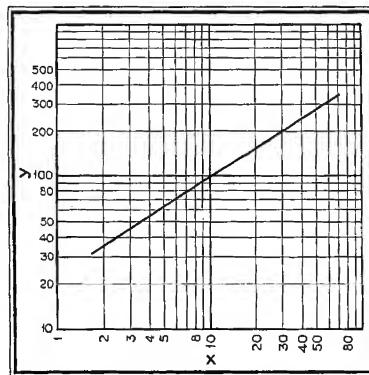


Figure 5

Figure 4, and plot them as shown. It is obvious that they follow the straight line form very closely. From Figure 1 we see that the empirical form to use in conjunction with a straight line is

$$y = mx + b$$

Forming equations from the various corresponding sets of  $x$  and  $y$  we have

**Group 1**

$$\begin{cases} 2.4 = m + b \\ 5 = 3m + b \\ 7.5 = 5m + b \end{cases}$$

**Group 2**

$$\begin{cases} 3.5 = 2m + b \\ 6 = 4m + b \\ 9 = 6m + b \end{cases}$$

adding the equations in each group we obtain

$$\begin{aligned} 14.9 &= 9m + 3b & 18.5 &= 12m + 3b \\ \text{Solving these two equations, we find} \\ m &= 1.20 & b &= 1.37 \end{aligned}$$

Thus, the law is

$$y = 1.2x + 1.37$$

Now, let us take another example. It can be found that by plotting the values of  $x$  and  $y$  shown in Figure 2 on log-log paper, the result will be a straight line. This indicates that the form

$$y = ax^n$$

from Figure 1 should be used. Before proceeding one must transform the power law form into the straight line form. This may be done by taking the log of both sides

$$\log y = \log a + n \log x$$

Then

$$y' = nx' + a'$$

where

$$y' = \log y, a' = \log a \text{ and } x' = \log x$$

Forming the equations with corresponding values, we have

$$\begin{cases} \log 35 = (\log 2)n + \log a \\ \log 100 = (\log 10)n + \log a \\ \log 300 = (\log 60)n + \log a \end{cases}$$

$$\begin{cases} \log 60 = (\log 5)n + \log a \\ \log 200 = (\log 30)n + \log a \end{cases}$$

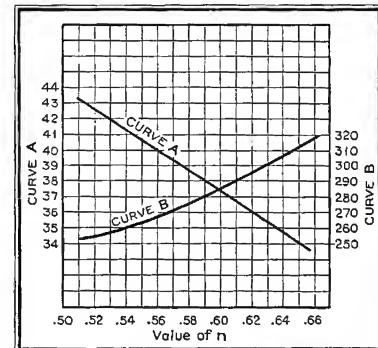


Figure 6

Performing the log operations and substituting for  $\log a$  and its equivalent  $a'$ , we obtain

$$\begin{cases} 1.544 = 0.301n + a' \\ 2 = n + a' \\ 2.477 = 1.779n + a' \\ 1.729 = 0.669n + a' \\ 2.301 = 1.477n + a' \end{cases}$$

Adding the equations in each group, we get

$$\begin{cases} 6.021 = 3.081n + 3a' \\ 4.081 = 2.176n + 2a' \end{cases}$$

Solving, we get  $a' = 1.44$  and  $n = .552$ . Putting these values in the straight line form, we have

$$y' = .552x' + 1.44$$

But  $a' = \log a = 1.44$ ; thus  $a = 27.5$ . Therefore, the power law is

$$y = 27.5x^{.552}$$

In Figure 2, we have a comparison of the observed and calculated values. It is soon apparent that the formula  $y = 27.5x^{.552}$  can only be used as a starting point from which to make additional trials. A few trials will soon reveal that the form  $y = 21.8x^{.56}$  yields values that correspond closest to the straight line in Figure 5. Figure 2 gives a table of values for several other combinations of  $n$  and  $a$ .

If one wished the curve to pass through the extreme points 2, 35 and

(Continued on page 30)

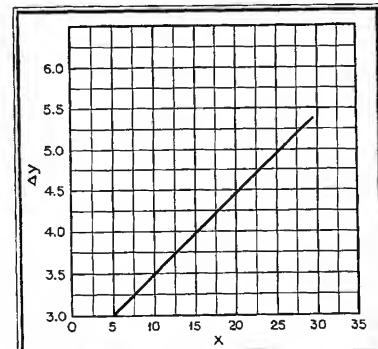


Figure 7

# Coastal RADIO-TELEPHONE SYSTEMS

by H. M. PRUDEN

Bell Telephone Laboratories

DURING the past decade, radio telephone service between shore and vessels off the coast of the United States or within its harbors has

undergone considerable growth and development. Such an extensive commercial service cannot come into existence overnight; the development work lead-

ing to the present successful system was begun over twenty years ago. The present installations, differing considerably from the first,<sup>1</sup> are the result not only of earlier commercial trials but of extensive research studies of radio transmission between ships and shore stations and of the most effective types of circuits to employ. As a result of all this work, a complete coastal radio system is now in use. It consists of fourteen basic shore stations<sup>2</sup> so located as to cover the entire coast from Maine, through the Gulf of Mexico, and up the Pacific Coast to Seattle.

Each of the fourteen shore stations includes a radio transmitter, two or more radio receivers, and terminal equipment for associating each with the other and with their signaling and control circuits. The terminal equipment is installed in the toll office, and two of such terminals in the Long Lines building are illustrated on this page in Figure 1. The transmitter is installed in some small building<sup>3</sup> erected for the purpose or in some telephone building or leased property. The receivers, however, are usually at some distance from the transmitters and are generally mounted on poles. Since the transmitting equipment aboard ship is not so powerful as that on shore, the shore receivers are spaced at shorter intervals than the transmitters. In general the receivers are so placed, that any ship that can be reached satisfactorily by a particular shore station, can in turn be picked up satisfactorily by one of the receivers associated with that shore transmitter.

## Shore Station Transmissions

Transmission from the shore stations is at a frequency within the band from 2,504 to 2,600 kilocycles, while the shore receivers operate at frequencies between 2,108 and 2,208 kilocycles. To call a shore station, the desired frequency is selected, the handset aboard ship is lifted, and the "talk" switch on the handle is pressed. This turns on the ship's transmitter and the radiated carrier causes a codan relay in one or more

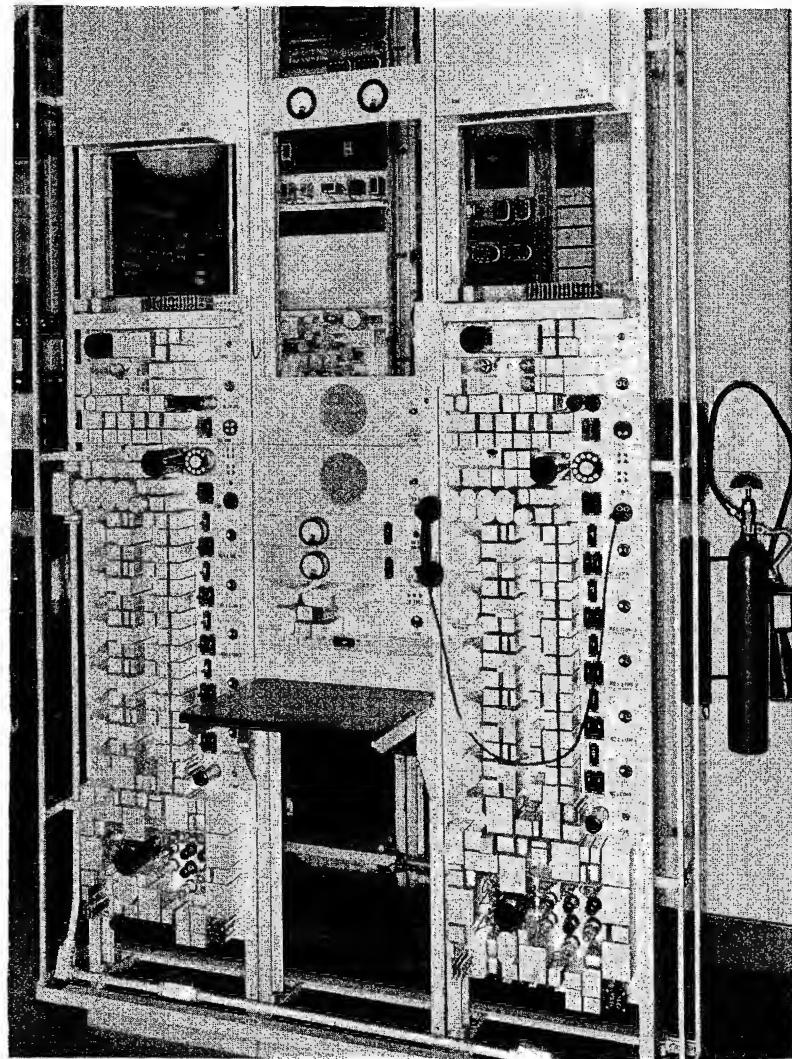


Figure 1  
Two of the coastal radio telephone terminal units that serve to join the nation and the world.

of the shore receivers to operate and light a lamp in front of an operator. The call is then answered by the operator and completed in the usual way through the connecting land lines.

#### Ship Calling Methods

Two methods are available for calling ships. The more completely equipped vessels have a selective signalling system as already described in the Record.<sup>4</sup> The operator dials the ship as she would any shore subscriber, and a bell is rung aboard the vessel called. In the earlier installations, the operator used a special dial, but a circuit has been developed, and is now in general use, that permits standard dials to be used. For ships not equipped for dial calling, the operator transmits a 1,000-cycle tone over the carrier from the shore transmitter, and then calls the ship by name or by its call letters. Such vessels have a loud speaker associated with their radio receiver, and the 1,000-cycle tone serves as an attention signal.

#### Operation Systems

The general method of operating at the shore station is indicated in Figure 2. Each receiver associated with that station is permanently connected to a monitoring jack at the switchboard. By plugging into this jack, the operator can monitor on the receiver at any time, either to identify calls or to select the best receiver for any particular call. Each receiver also has its line lamp, which is lighted when the carrier-operated relay of the receiver operates. When a ship calls shore, it may be so situated that the carrier-operated relays of all the shore receivers of that station operate. When this occurs, the operator may select the receiver which, on the basis of past experience, is generally the best one. If this selection gives satisfactory transmission, the call can be completed. After this is done, the operator may check the reception on the other receivers by plugging in to the monitoring jacks. If she finds that another receiver is providing better signals than the one she originally selected, the connection may be quickly transferred to the better receiver.

#### Line Lamp Control

Plugging into the line jack associated with any receiver, actuates a connecting relay that extinguishes the line lamps, turns on the radio transmitter, and connects the receiver to the line jack through an amplifier. Operation of the

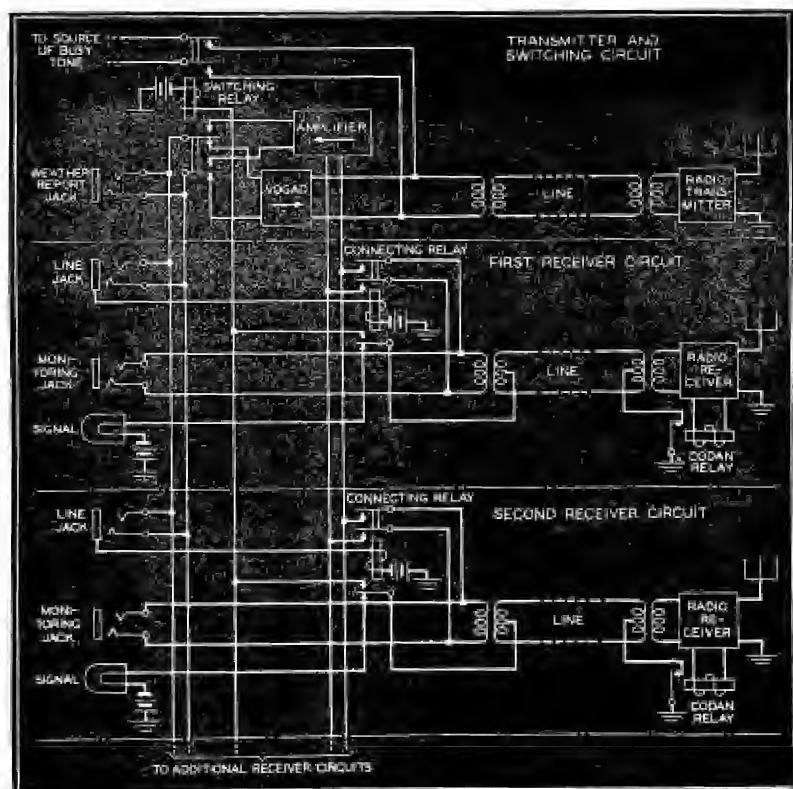


Figure 2

A schematic diagram of the shore circuit that is used in the coastal radio service. Every provision for rapid service is included, with suitable arrangements for busy signals, etc.

connecting relay also switches the ground connection from the carrier-operated relay to a switching relay, which operates and remains operated as long as the ship's carrier is on. In its operated position this switching relay connects the line jack to the radio receiver but in its unoperated position, it connects the line jack to the radio transmitter. After someone aboard the ship has called shore by turning on his transmitter and announcing the name of the shore station being called, he releases the "press" switch, and listens. This releases the switching relay at the shore station, and the operator answers, gets the shore number wanted, and completes the connection.

the ship receivers are tuned to the frequency of the shore transmitter and not to that of the ship transmitter. He might thus assume that the circuit was idle, and call shore, thus interfering with the ship already calling. When the shore station is talking a busy signal is not needed because all ship receivers are tuned to the shore transmitting frequency, and thus can hear the shore end of the conversation. A weather-report jack is also associated with each station to permit weather reports and hydrographic information to be sent out without connecting any receivers to the switching circuit.

#### Transmitters Used

While the ship is talking, a busy signal is connected to the input of the shore transmitter through contacts on the switching relay, so that, should someone on another ship listen before starting to call shore, he would hear the busy tone, and wait until the channel was available. Without this arrangement someone aboard ship picking up his telephone while some other ship was talking would hear nothing, because

Since the first commercial installation<sup>5</sup> of a coastal radio station some dozen or so years ago, the only major item of equipment that has not undergone substantial modification is the shore transmitter, the 9C. This was a modification of the 9A transmitter,<sup>6</sup> originally developed as a ground station for aircraft radio communication. The shore receiver<sup>7</sup> is a much more recent development, and was designed as a result of previous experience with this service. It is completely self-con-

tained, and remotely operated, and maintenance is greatly assisted by use of circuits<sup>8</sup> developed for the purpose.

#### Type of Equipment

The radio equipment aboard ship varies not only because of the large range in size of the vessels but because of the service they are engaged in and the particular preferences of their owners. The Western Electric Company has made three radio sets available. One of them, the 224B radio telephone equipment<sup>9</sup>, meets the needs of the majority of coastwise vessels and the larger yachts. The other two, the 226D<sup>10</sup> and the 227B radio telephone equipments, are smaller, and are designed particularly for the smaller yachts and for harbor craft.

#### Ship-Shore Talk

Besides completing calls between ship and shore, the terminal facilities also permit radio telephone conversations between ships through a shore station. The operating procedure is for the ship to call shore and ask for a connection to some other ship. The shore operator then calls this other ship, and having reached it, plugs into a by-pass jack, which, through contacts not shown, rearranges the circuit as indicated on Figure 4. The output of the radio receiver is connected to the input of the radio transmitter through a network, so that received speech is retransmitted at a frequency that can be detected by either vessel.

#### Emergency Radio

One of the innovations in the new terminal equipment is the ability to

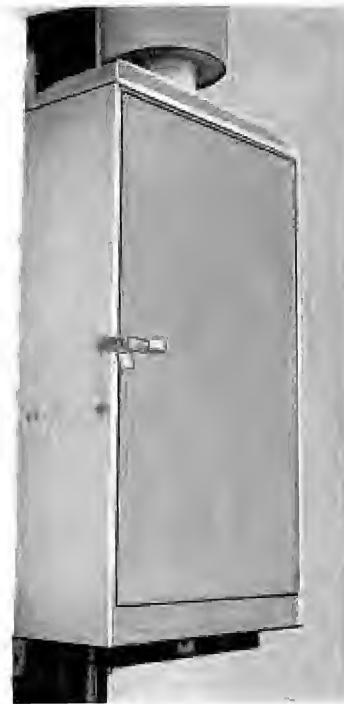


Figure 3

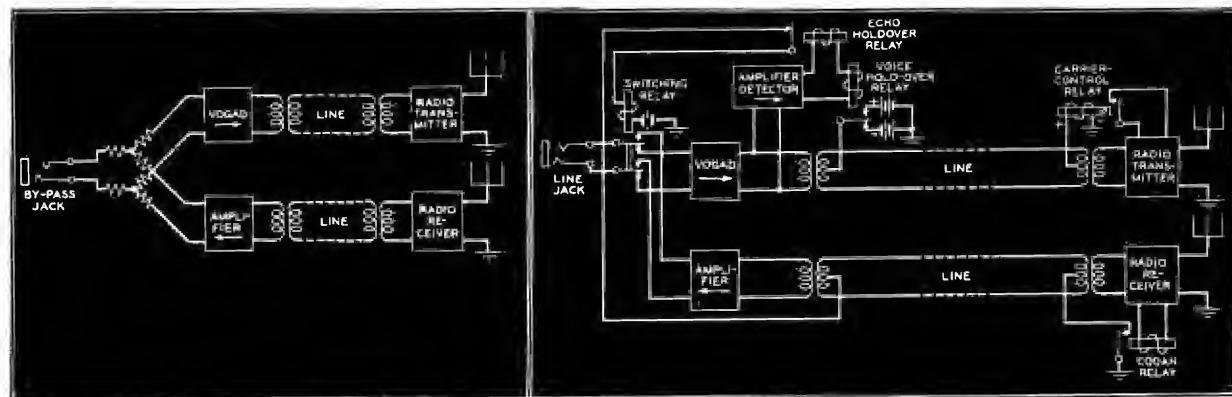
A typical shore receiver installed in a decorative brick kiosk on the grounds of a hotel.

make contact with the emergency radio equipment<sup>11</sup> of the telephone companies. This emergency equipment is designed to take the place of wire facilities that are temporarily out of service. The ability of the shore stations to communicate with these emergency sets is very helpful at times in establishing the original connection, since then only one of the emergency sets is required, the shore station taking the place of the other.

A second emergency equipment is put into use as soon as possible, however, and the operating frequency changed, so as not to tie up harbor equipment. The shore station radiates carrier continuously while handling calls with vessels, while for the emergency equipment the carrier must be under voice control. To make this possible, the technical operator is provided with a key that rearranges the circuit as shown in Figure 5. The switching relay operates as in Figure 2, under control of the incoming carrier, to connect the shore circuit to the radio receiver. Under these conditions, there is no speech input to the vagad and hence none to the amplifier-detector. As a result there is no current through the winding of the voice holdover relay, and a circuit through its back contact disables the radio transmitter. When incoming speech ceases, the switching relay releases, thus connecting the shore circuit to the transmitter. Voice signals from the shore circuit result in a current in the output of the amplifier-detector that operates the voice-holdover relay, and causes the transmitter to radiate carrier. The same current also operates the echo holdover relay, thus opening the circuit to the switching relay so that incoming speech cannot interfere with the transmission of outgoing signals.

#### References

The following Bell Lab. Record issues are referred to: (1)—Jan. 1930, pp. 204; (2)—Jan. 1941, pp. 166; (3)—Dec. 1938, pp. 134; (4)—Apr. 1936, pp. 255; (5)—Nov. 1932, pp. 62; (6)—Oct. 1930, pp. 65; (7)—Nov. 1939, pp. 76; (8)—Nov. 1939, pp. 91; (9)—June 1938, pp. 358; (10)—Sept. 1938, pp. 21; (11)—Feb. 1939, pp. 198.



Figures 4 (Left) and 5 (Right)

In Figure 4, we have an arrangement of a shore circuit for a ship to ship call. In Figure 5 is an arrangement of the shore circuit for communication with an emergency telephone system.

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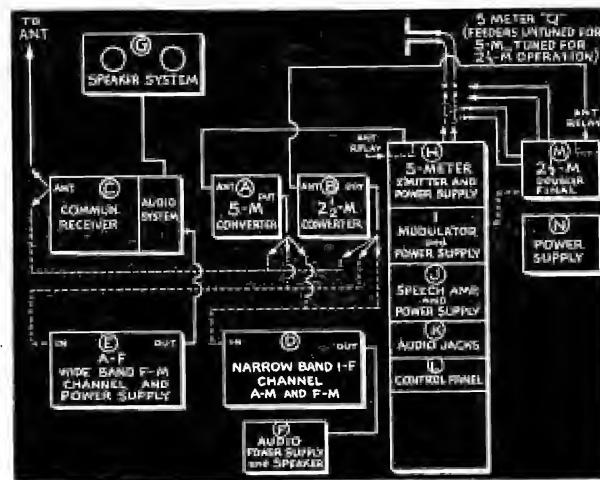
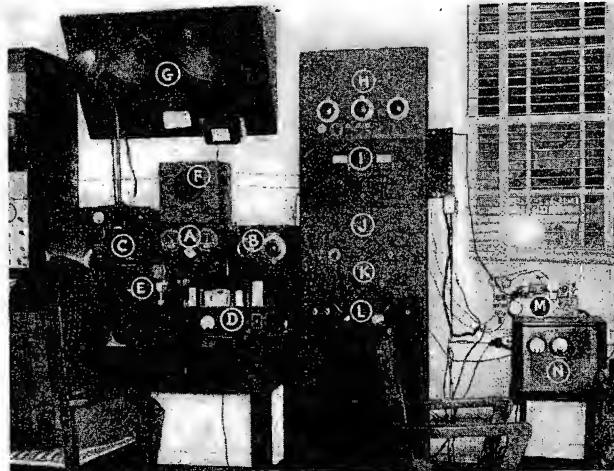
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*Main section of the new RCA Laboratories under construction at Princeton, N. J. This section will open in 1942. Inset shows the Laboratories as they will look when completed.*



## Civil Defense

# EMERGENCY COMMUNICATION NETS



Figures 1 (left) and 2 (right)

Amateur key station of the defense network system. Features include use of f-m channel for reception of 2 1/2 meter transceiver field units, extension of 5-meter transmitter operation to 2 1/2 meters with minimum duplication of equipment, and provision of gas generator as emergency power supply. In Figure 2, we have a block arrangement explanation of the various units used in this station.

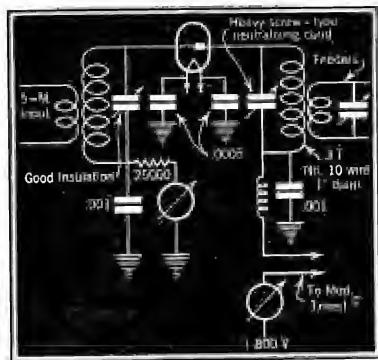


Figure 3

The 2 1/2 meter doubler-final, with an HK-54 operating at 800 volts, 100 ma. input.

**V**OOLUNTEER emergency communication nets, manned by radio amateurs, have sprung up all over the country during recent months, as a part of local defense organizations. Their function is to provide communication links such that, should telephone lines be interrupted during an emergency, the work of local defense agencies can still go on, properly coordinated and directed. Portable equipment, rushed to such strategic points as de-

## Notable features in volunteer networks; an effective link in defense work today.

by S. GORDON TAYLOR

fense council headquarters, police and fire headquarters, the Red Cross, or the scene of a disaster, offers also a vital medium of communication, so that orders and information can pass freely back and forth.

With the declaration of war, at which time all amateurs were ruled off the air, this type of service was suspended only briefly. Within a matter of days the FCC was issuing special authorizations for continued operation to amateurs whose services and equipment were certified by local defense or municipal officials as being important to their local defense program. A certain amount of confusion then arose, evidently due in large part to the issuance of these authorizations without any definitely formulated general plan for insuring most effective utilization of the amateurs and their equipment. Early in January all these special authorizations were re-

called without official explanation. At the time of this writing it is understood that new authorizations will soon be issued just as soon as a coordinated plan can be formulated. It is believed that this time the requirements will be that local defense officials not only must certify individual amateurs to the Defense Communications Board, but must at the same time submit details of their emergency communications plans (existing or proposed) for approval by the DCB. One purpose of the latter requirement is thought to be an effort on the part of the DCB to insure maximum utilization of the facilities offered by the amateurs. Thus it is possible that in certain localities a more effective communications network could be established on a county-wide rather than purely local basis. Then should an emergency arise in any part of that county the entire communications unit,

or such part of it as may be needed, could be thrown in at that point (which might be a town with no ham residents and therefore without any facilities for its own emergency communications net). Moreover, a group of neighboring communities might each have too few amateurs to form effective individual networks but by pooling their "ham-power" could readily overcome this obstacle.

There will probably be instances where individual towns will have their own communications units, but with plans so coordinated that these units can be thrown together under a master control plan when occasion arises.

Whatever the plan under which emergency communications service is continued, many men engaged professionally in the communications field will participate either by virtue of their official connections with police or other existing radio systems, or as holders of amateur licenses. It is therefore believed that many will find more than passing interest in some of the rather unique features of a local communications unit organized many months ago in the Eastern part of the country.

#### Bands Used

This unit as now organized operates in the  $2\frac{1}{2}$  meter band exclusively, but its key station is also equipped for 5 meter operation and these latter facilities may be later utilized for extended inter-community activity. The  $2\frac{1}{2}$  meter band was selected for obvious reasons, most important of which is the easier portability of field equipment designed for this range.

Equipment of the key station is shown in the photo of Figure 1, with details in Figures 2, 3 and 4. The transmitter equipment consists of a rack-and-panel 5 meter phone unit and a separate  $2\frac{1}{2}$  meter final stage, which is driven by the output of the 5 meter transmitter and also utilizes the modulator of the latter. Thus with minimum duplication of equipment this station is able to put out a crystal-controlled signal on either  $2\frac{1}{2}$  or 5 meters. The power output on 5 meters is between 40 and 50 watts. About 80 watts are fed into the plate circuit of the  $2\frac{1}{2}$  meter final. Because it serves also as a doubler its efficiency is lowered but the important fact is that it is capable of putting a healthy signal into every part of the town's area of close to 50 square miles. It therefore fulfills its mission and suggests simple means whereby any station already equipped for 5 meter operation can shift down to  $2\frac{1}{2}$ .

The circuit of this doubler-final is shown in Figure 3. It is built up on a

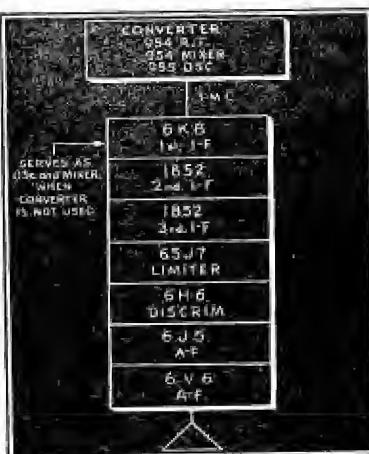


Figure 4

Tube line-ups when working either converter into either f-m channel. The 5K8 tubes serve as oscillator-mixers for straight f-m broadcast reception without converters.

standard chassis which is shown atop its power-supply cabinet at the extreme right of Figure 1. The usual precautions are taken to insure minimum length of leads and to assist in this the HK-54 is mounted horizontally—a simple way to avoid tall standoff supports for the various components. Otherwise construction is quite conventional. Perhaps the most important requirement of such a doubler-final is plenty of grid drive if it is to provide reasonably good output. In this case the

HK-54 is operated at only about one-third its rated input, yet the full 40-50 watt output of the 5 meter stage is utilized in driving it.

#### 5 Meter Q Antenna

The antenna is a 5 meter "Q" mounted about 85 feet above ground. For 5 meter operation this is fed with 2" spaced feeders, untuned. By tuning the feeders this same antenna becomes an effective  $2\frac{1}{2}$  meter radiator. It is of incidental interest that in this instance the feeder length, shack to antenna, is approximately 220 feet.

The receiving facilities of this station are of special interest because of the unusual flexibility provided and the fact that an f-m channel is utilized for  $2\frac{1}{2}$  meter reception. The schematic of Figure 2 conveys some idea of the complete adaptability. Separate converters are used for  $2\frac{1}{2}$  and 5 meters and either of these can be worked into (1) a wide-band f-m channel, (2) a narrow-band a-m/f-m channel, or (3) a conventional communications receiver. The tube line-up shown in Figure 4 applies to both converters as well as to both f-m i-f channels.

Because the field units are modulated oscillators their signals are not intelligible on any standard a-m superhet. It is seldom if ever, however, that they are not completely understandable with a converter working into the wide-band f-m channel. This latter combination is likewise a welcome alternative to a superregenerative receiver because it combines better selectivity and sensitivity with excellent signal to noise ratio and freedom from rush. Perhaps the best evidence of the effectiveness of the receiving set-up is found in the fact that the  $2\frac{1}{2}$  meter field units, which operate with a little over 1 watt input when in the transmit position, and may use only small telescoping radiators mounted right on their cases, can be picked up intelligibly from anywhere within the town's limits—and this is mighty hilly terrain.

The field units employed are all of a single type—the Abbott DK-3 transceiver. Instead of the conventional  $\frac{1}{4}$  or  $\frac{1}{2}$  wave rod antenna, they employ the J type. Not the least advantage of these antennas is that they elevate the radiator by the length of the matching stub. While this is only a matter of 2 feet, it means a lot because it helps to isolate the radiator from surroundings (such as the transmitter case and the operator's body) and in addition this type of antenna seems to couple more efficiently.

All units include self-contained bat-  
(Continued on page 20)

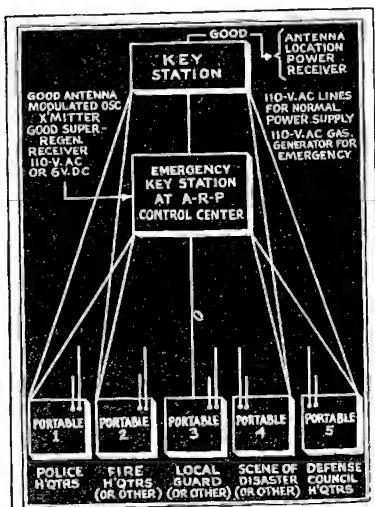


Figure 5

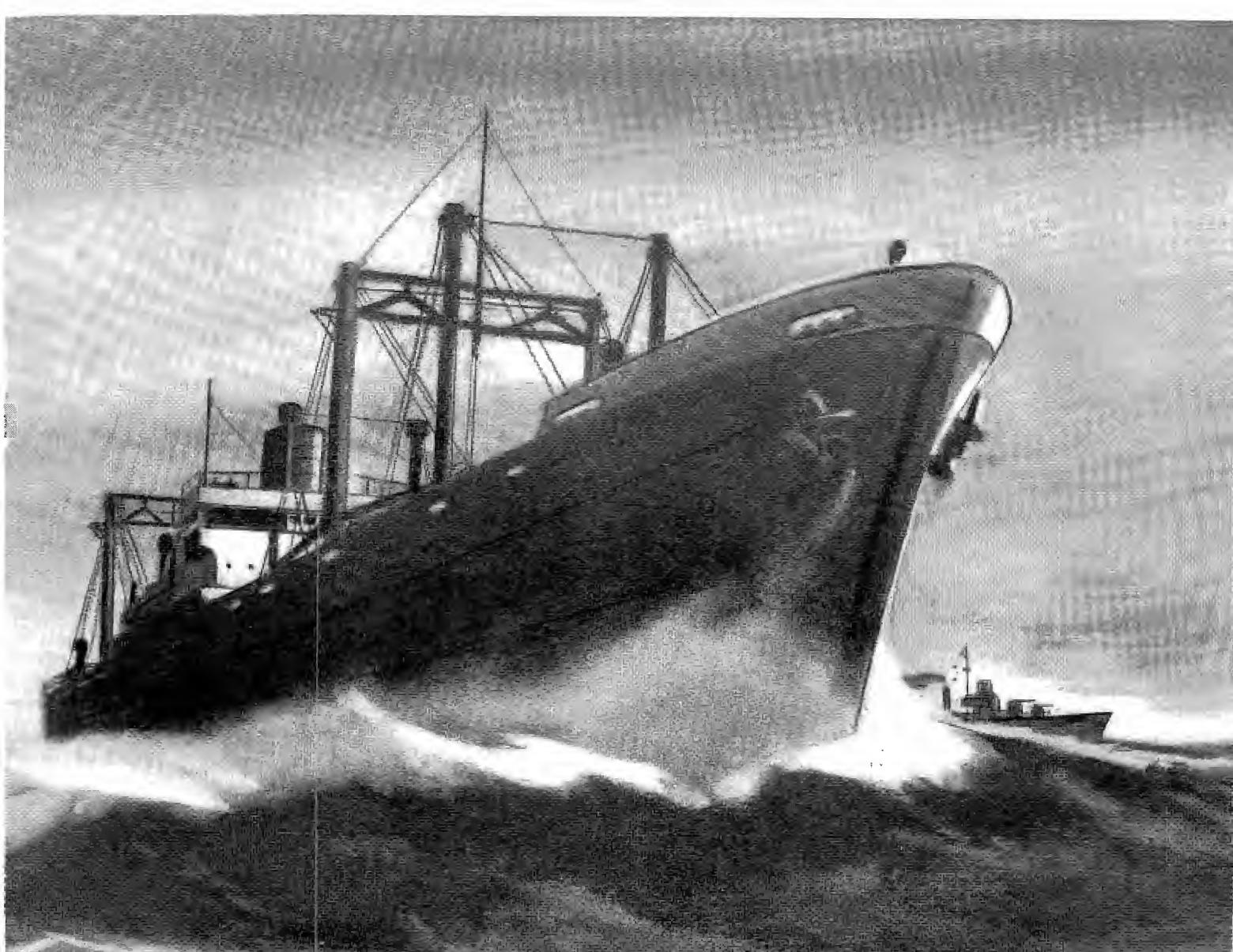
Operating plan of the network. Control is vested in either the key station or the control station at Air Raid Precautions center, depending on the nature of an emergency. When the ARP station takes over, the better located and higher powered key station serves as a relay station between this and the remote station.

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## EMERGENCY NETWORK

(Continued from page 17)

teries but have also been equipped with plug and cable arrangements whereby in test drills they can be operated from an external battery box, thus saving the self-contained batteries for actual emergency service.

It was mentioned earlier that in practically all defense communications nets the amateurs supply their own equipment. This area is one exception to this, at least to the extent that the Defense Council purchased all field units.

### General Operating Plan

The general operating plan under which this net works, is shown in Figure 5. This is quite similar to the State Police radio set-up. The field units, because of their low power, cannot be depended upon for intercommunication among themselves in this hilly country, particularly when operating with antennas only a few feet above ground. All communications therefore clear through either the key station or the emergency control station at the ARP (Air Raid Precautions) control center. Normally the key station maintains control of the net but when circumstances require control can be swung over to the station at the ARP center, in which event the key station functions simply as a relay station between this control station and such field units as cannot communicate direct with the control.

While the control station is not as favorably located as the key station, nor does it have either the power or equipment of the key station, it does offer the advantage that during air alarms, for instance, it is located right in the heart of the activity center where its operator is easily accessible to the officials in control. Field units 1 and 5 (Figure 5) are definitely assigned to police and defense headquarters and proceed there at once on the sounding of an alarm. Other units report in to the key station (over the air) and are given assignments as soon as the key station has obtained reports on the situation from units 1 and 5.

The field units have the advantage that their self-contained batteries permit them to be operated anywhere—walking, from a car or inside a building. To help offset their low power and limitations of their antennas, permanent antennas and feeder systems have been placed on roofs of various buildings occupied by defense agencies, particularly the defense and police headquarters locations. Field units assigned to these buildings can disconnect their portable

tendencies of the business center in which these buildings are mostly located.

A check-up with members of several defense nets shows a preponderance of opinion in favor of  $2\frac{1}{2}$  meters as the most practical band for local net operations. Some favor 5 meters for tie-up links between key stations of cooperating nets in neighboring communities. Where both types of operation are to be carried on simultaneously, this two band arrangement helps to reduce local QRM. This is a particularly important consideration where super-regenerative receivers with their relatively broad tuning characteristics are universally employed. (It is reported that the new authorizations may limit amateur emergency operations to these and still higher frequencies.)

### Power Requirements

This brings up the important matter of power requirements. Even for key stations a reasonably efficient transmitter working with 10 to 50 watts into the final (or modulated oscillator) will meet most requirements. Under unusual conditions power in excess of this way may be necessary; otherwise it is distinctly undesirable because of the QRM that may be caused in neighboring communities where other nets are in operation. As a matter of fact it is usually the case that the field units could use higher power to better advantage than key stations, as a help in compensating for their relatively inefficient antenna system. This is one reason why equipment such as the 20 watt unit shown in Figure 7 is gaining favor. Such power is entirely practical where operation can be from a car and utilize the car battery and a 300 volt, 100 ma. standard vibrator supply. It is at the same time adequate for operation from fixed locations such as key stations, sub-control stations, etc. In the latter service it is of course important that either a generator or a storage battery and vibrator supply be available in case the light lines fail. Whether or not this battery is to be used exclusively there should be provision for charging it. It is usually more practical in fixed locations to operate from the light lines if such are available, holding the 6-volt supply equipment in reserve for emergency use should the power lines fail. The same vibrator supply can be used in the car, where suitable plug-in arrangement for this and the transmitter-receiver unit can be fixed up to permit speedy change-over of equipment from fixed-station to mobile or portable operation.

Antenna requirements vary with cir-

(Continued on page 32)



Figure 6

Periodic check-up of one of the portable field units. These check-ups include not only battery tests, but actual measurements of transmitted signal and other operating characteristics.

antennas and substitute the feeder connections, thus insuring better results amidst the electrical noise and absorp-

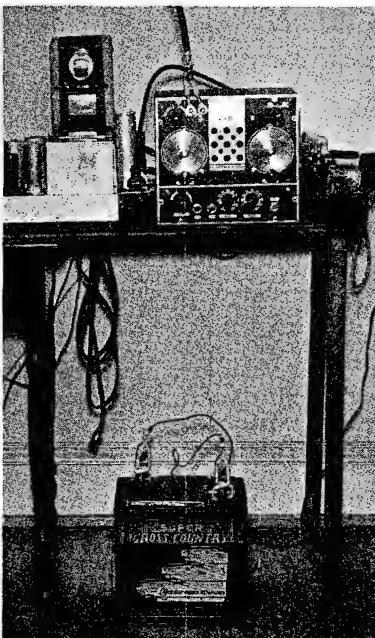
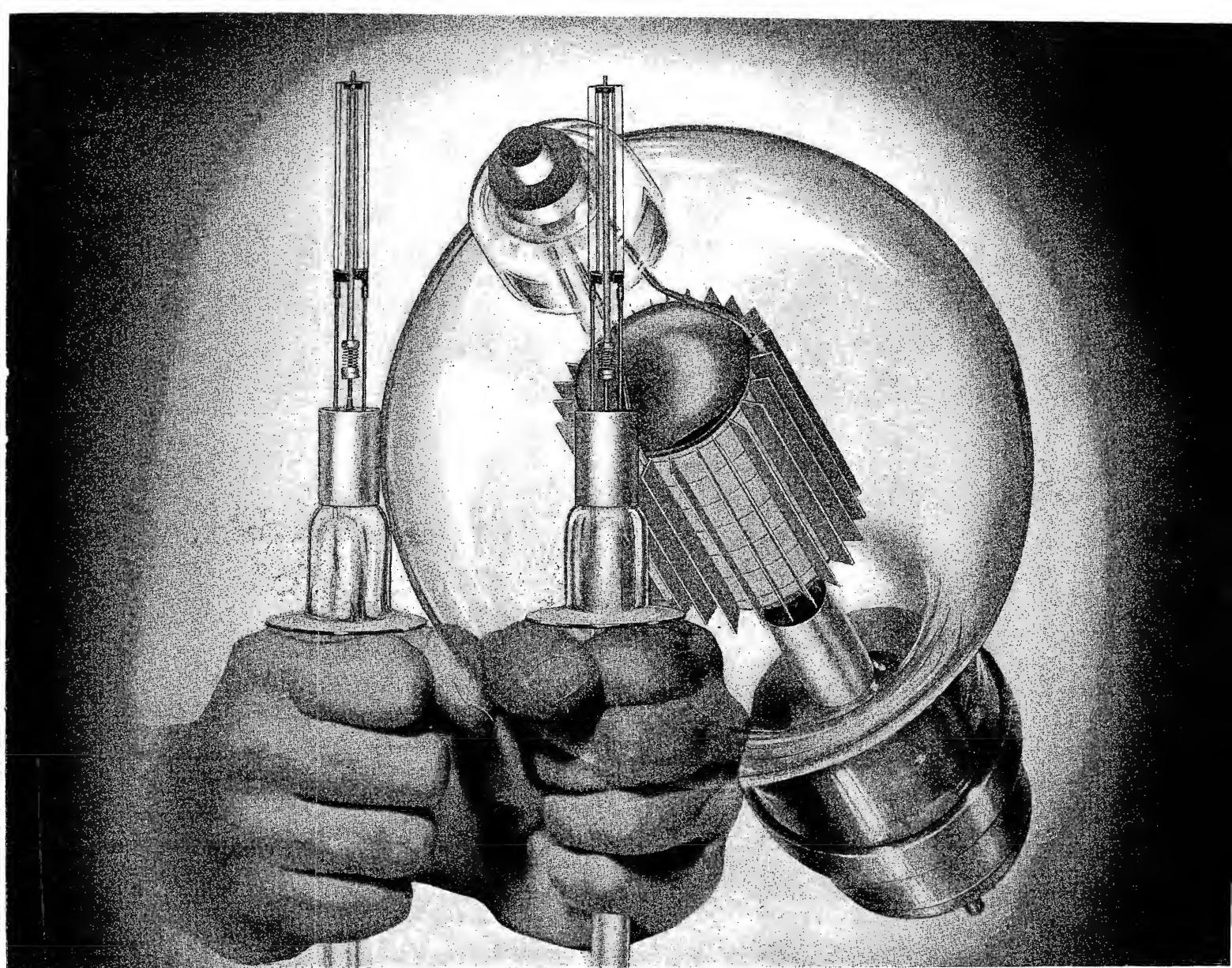


Figure 7

Transmitter-receiver in use in a section-control station of this unusual emergency net. At the left are the vibrator supply and battery charger and below the storage battery, which constitute the emergency power supply.



## How Important is a Filament?

**I**t's a well known fact that the vacuum tube is the heart of radio communications, but it is important to remember that the filament is the heart of the vacuum tube! Thus, the efficiency with which these tiny strands of tungsten wire perform may mean the difference between success and failure of the tube itself...victory and defeat for tanks or battleships...life and death for millions of people.

You can't always tell by appearance whether a filament is efficient or not. The two assemblies shown above look exactly alike but when put to the test one may not do its job. Into the production of filament for Eimac tubes has gone much research and experimentation. Among the many special instruments designed and perfected by Eimac to insure perfect filaments, none is more interesting than the electron microscope which virtually gives a moving picture of how a filament works under actual operating conditions.

Behind every Eimac tube is the assurance that its

filament will function at top efficiency. Contributing factors to this efficiency are: Tantalum plates and grids and the super-vacuum which removes all contaminating gas particles. All these factors and more are what make it possible for Eimac tubes to carry the unconditional guarantee against emission failure caused by gas released internally.

**Eimac's unusual performance capabilities are receiving enthusiastic acceptance in all branches of the service... ARMY, NAVY and the AIR CORPS**

*Follow the leaders to*

**Eimac**  
TUBES

Eitel-McCullough, Inc.  
San Bruno, California

# NEWS BRIEFS OF THE MONTH - - -

## IRC PROMOTES EHLE AND BEEBE



Harry Ehle (top)  
Harold G. Beebe  
(bottom)

requirements for various types of IRC fixed and variable resistors.

Robert Elmore, a newcomer to the IRC organization, will assist Mr. Beebe in industrial division sales and engineering work.

\* \* \*

## SLOAN TO WPB COMMUNICATIONS

William M. Sloan, widely known communications engineer, now heads the telegraph and cable section of the Communications Branch. A graduate of Montana State College and of the University of Wisconsin, Mr. Sloan served as a captain in the United States Army Air Corps during the last war. Before the war ended, he was made Communications adviser to the Postmaster General.

\* \* \*

## AUDIO DEVICES FOLDER

Blanks of metal and glass, are effectively described in an 8 page folder, just released by Audio Devices, Inc., 1600 Broadway, New York City.

\* \* \*

## JOLLIFFE PROMOTED

Dr. Charles B. Jolliffe has been appointed assistant to the president of RCA. Dr. Jolliffe, in addition to his new duties, will continue the position he has held for some time as chief engineer of the RCA Laboratories.

\* \* \*

## ALFORD'S RESEARCH AND DEVELOPMENT PLAYED MAJOR ROLE IN SECTOR IDENTIFICATION PROJECT

From A. G. Kandoian of the International Telephone and Radio Laboratories, it has been learned that Andrew Alford's contribution to the Two Course Radio Range with Sector Identification, described in the January issue of COMMUNICATIONS was a major one. Most of original ideas on which this development was based were those of Mr. Alford.

## GOVERNMENT SEEKS MORE RADIO OPERATORS

The War Department, Federal Communications Commission, Civil Aeronautics Administration, Coast and Geodetic Survey, and other Government agencies need radio operators.

To fill the jobs, which pay \$1,620 and \$1,800 a year, an examination was recently announced by the Civil Service Commission. Because of the large number of vacancies which exist applications will be accepted at the Commission's Washington office until further notice.

While no paid experience is required, applicants for these positions must show that they are able to transmit and receive messages by radio-telegraph at a rate of 20 words a minute, transmitting either by hand or bug. For some positions persons are needed who can operate a regular typewriter at 40 words per minute, or a teletypewriter at 35 words per minute. The age limits are 18 to 55. Persons are to be rated on their experience or training and fitness to perform the work.

Operators who are interested in this work and who would be available for Government employment are urged to secure the proper application forms from the Commission's representative at first- or second-class post offices, or direct from the Commission in Washington.

\* \* \*

## CBS'S CHIEF ENGINEER AWARDED IRE FELLOWSHIP

Adolph B. Chamberlain, since 1931 chief engineer of the Columbia Broadcasting System, has been awarded an honorary engineering fellowship of the Institute of Radio Engineers for engineering leadership in broadcast transmission and operation.

\* \* \*

## ARGENTINE ENGINEERS AT IRE SHOW

Four members of the Buenos Aires section of the IRE, the first section in South America and the only section in any Spanish speaking country, attended the recent convention in New York City. They were Senor Adolfo Cosentino, past vice president of the I.R.E., past president of the Buenos Aires section, Chief of Radio-communications of the Argentine; A. M. Stevens, past president of the Buenos Aires section, manager of the Compania International de Radio Argentina; LeRoy Simpson, engineer with the RCA of the Argentine, present secretary of the Buenos Aires Section, and Luis Guarana, radio engineer with RCA, Camden, N. J., and RCA Buenos Aires.



Left to right: Le Roy Simpson, A. M. Stevens, Adolfo Cosentino and Luis Guarana.

## THROCKMORTON AND SHANNON ADVANCED



George K. Throckmorton (top)  
Robert Shannon (bottom)

study war problems.

George K. Throckmorton, for the past five years president of the RCA Manufacturing Company, Inc., of Camden, N. J., has been elected chairman of the executive committee. Robert Shannon, former executive vice-president, has been elected president.

"Bob" Shannon, as he is affectionately known by thousands of employees, started as a factory worker thirty years ago. He has occupied various executive positions in the R. C. A. organization during the past twelve years.

The executive committee will

\* \* \*

## FM USED IN TRANSIT SYSTEM

A new two-way GE f-m radio system has recently been installed in the Cleveland Railway Company's transit system. The equipment consists of a 250-watt dispatcher transmitter and ten 25-watt mobile units. The headquarters transmitting antenna is mounted 270 feet above street level.

Since the installation of this new emergency communication system, delays in car service have been shortened and in some cases entirely eliminated by the ability of zone supervisors to reach a congested area quickly and to restore the flow of vehicles or direct the replacement or repairs of damaged equipment. Ten zone cars are operated throughout the city, patrolling the lines of the company.

\* \* \*

## TECHNICAL APPLIANCE MOVES

Technical Appliance Corporation has moved into new and larger quarters at 516 West 34th St., in New York City.

\* \* \*

## VARIABLE SPEED TRANSMISSION CATALOG

Data on variable speed pulleys, variable speed transmissions, automatic tension control motor bases are contained in a 52 page book just issued by Ideal Commutator Dresser Co., Sycamore, Ill. Sizes, rated capacities, design and operating details, where applicable, how installed, are also supplied.

A free copy is available to design engineers, mechanics, purchasing agents, etc.

\* \* \*

## SYLVANIA TUBE CHARACTERISTICS SHEET

A new renewal tube characteristics sheet has been released by the commercial engineering department of Hygrade Sylvania.

A new type format distinguishes this sheet from previous editions. Each tube

type is horizontally ruled off so that any particular characteristic desired can be seen at a glance.

In twelve-page booklet style, it contains not only average tube characteristics, but also panel lamp characteristics and tube and base diagrams.

\* \* \*

#### HAROLD SEE NAMED SENIOR TELEVISION SUPERVISOR

Harold P. See has been appointed senior television supervisor of NBC Television. See, who takes over his new duties immediately, succeeds F. A. Winkel, recently named New York division engineer.

In his new capacity See will be in immediate command of all field and studio engineering activities of NBC television. He continues as Television Field Supervisor, but will have the aid of an assistant, A. E. Jackson.

\* \* \*

#### WELTRONIC BULLETIN RELEASED

A four page leaflet covering a new transceiver, a 4-lb. combination ultra short-wave, self-contained transmitter and receiver, has been released by the Communications Division, Weltronic Corporation, E. Outer Drive, Detroit. Copies are available directly from Weltronic.

\* \* \*

#### JOHNSTONE RETURNS TO NETWORKS

G. W. (Johnny) Johnstone, director of radio for President Roosevelt's 1940 re-election campaign and more recently chairman of the radio division of the Committee for the Celebration of the President's Birthday, has been appointed director of news and special features for the Blue Network.

\* \* \*

#### AUSTRALIAN RADIO ENGINEERING HONOR TO GRAHAM

The honor of Fellow Grade in the Australian Institute of Radio Engineers has just been conferred upon Virgil M. Graham, director of the radio tube application engineering department, Hygrade Sylvania Corporation, Emporium, Penna. Only twenty-two persons have been elevated to Fellow Grades in Australian I.R.E.

\* \* \*

#### ACME TRANSFORMER CATALOG

A new catalog, No. 155, covering radio and industrial transformer, has just been released by Acme Electric Transformer, Cuba, New York.

\* \* \*

#### PAUL WARE HEADS RADIO CLUB OF AMERICA

Paul Ware veteran radio amateur and professional was recently elected president of the Radio Club of America. Mr. Ware headed one of the original neutrodyne manufacturing enterprises, Ware Radio Corporation, from 1923 to 1926. Later he served as engineer-consultant for the original Sonora, Thompson Neutrodyne, Split-dorf-Bethlehem and Emerson. In 1936 he joined the P. R. Mallory Co., collaborating in the development of the new Mallory-Ware inductive tuning system. Since 1939 he has been associated with Allen B. Du Mont Labs., Inc., of Passaic, N. J., in connection with various engineering and production problems.

\* \* \*

#### POST OFFERS HELP TO CONTRACTORS

Under government requirements all holders of defense contracts must file with the

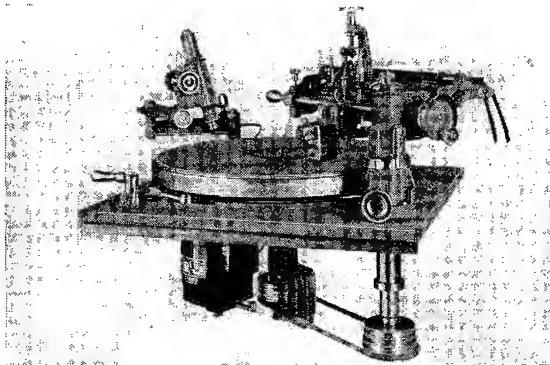
(Continued on page 25)

## TWO VALUABLE NEW FEATURES HAVE BEEN ADDED TO THIS PRESTO RECORDER!



Here is a more versatile recording turntable, a recorder with variable cutting pitch, one that can be quickly adjusted for discs of varying thickness, a machine that will operate "faster" in busy control rooms. It's the new Presto 8-C recorder with ...

**INDEPENDENT OVERHEAD CUTTING MECHANISM:** The cutting mechanism of the 8-C is rigidly supported at one end by a heavy mounting post  $2\frac{1}{4}$ " in diameter. The other end is free of the table so that the alignment is independent of the disc thickness. A thumbscrew above the cutting head carriage adjusts the angle of the cutting needle *while cutting* for any direct playback or master disc from  $.030"$  to  $\frac{1}{4}$ " in thickness. The cutting mechanism swings clear of the table for quick change of discs.



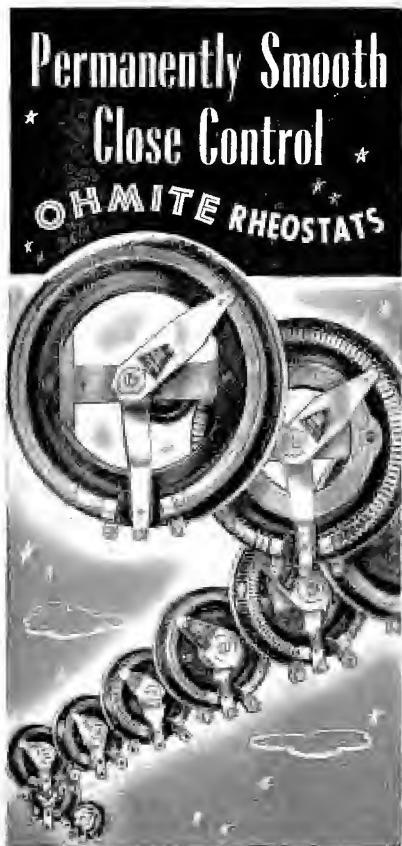
**VARIABLE CUTTING PITCH:** The buttress thread feed screw is driven by a belt and two step pulleys beneath the table giving accurate cutting pitch adjustments of 96, 112, 120, 128 or 136 lines an inch. Changing the cutting pitch is a matter of seconds. A hand crank and ratchet on the feed screw spirals starting and runout grooves up to  $\frac{1}{4}$ " apart.

Other specifications are identical with the well-known Presto 8-N recording turntable described in our complete catalog. Copy on request. Cabinets are available for mounting single or dual turntable installations. If you are planning to improve your recording facilities write today for price quotations and detailed specifications.

**PRESTO**  
RECORDING CORP.  
242 WEST 55th ST. N.Y.

In Other Cities: Phone: ATLANTA, Jack. 4372 • BOSTON, Bel. 4510  
CHICAGO, Har. 4240 • CLEVELAND, Me. 1565 • DALLAS, 37093 • DENVER,  
Ch. 4277 • DETROIT, Univ. 1-0180 • HOLLYWOOD, Hil. 9133 • KANSAS  
CITY, Vic. 4631 • MINNEAPOLIS, Atlantic 4216 • MONTREAL, Wel. 4218  
PHILADELPHIA, Penn. 0542 • ROCHESTER, Cul. 5548 • SAN FRANCIS-  
CO, Yu. 0231 • SEATTLE, San. 2560 • WASHINGTON, D.C., Shep. 4003

World's Largest Manufacturers of Instantaneous Sound Recording Equipment and Discs



IT'S the way Ohmite Rheostats are designed and built that insures the smooth, dependable, trouble-free control so essential today for Industry and the Armed Forces. You'll find them in radio transmitters, electronic devices, laboratory apparatus and production equipment . . . you'll find them in airplanes, ships, tanks and submarines.

THE wide range of types and sizes provides the exact unit for each need. There are ten wattage sizes, in standard or special designs from 25 watts to 1000 watts, from 1 $\frac{1}{8}$ " to 12" diameter. Many stock resistance values. Special variations produced to your specifications or engineered for you.

**Send for Catalog and Manual No. 40**

Write on company letterhead for complete helpful 96-page Catalog and Engineering Manual No. 40.



**OHMITE MANUFACTURING CO.**  
4870 Flournoy Street Chicago, U.S.A.

*Be Right with*  
**OHMITE**

*Fifth Annual*

# BROADCAST ENGINEERING CONFERENCE

*At Ohio*

THE ordinary problems of broadcast engineers have been supplemented by many new ones because of the present emergency. The introduction of new procedures and plans to cope with this new situation are thus of vital import, and as such formulated the bases of discussion at the Broadcast Engineering Conference of 1942 at Columbus, Ohio, February 23 to 27.

The opening address, Communications in National Defense, by E. K. Jett, effectively introduced the theme of the present conference. Mr. Jett is chief engineer of the Federal Communications Commission and chairman of the important Coordinating Committee of the Defense Communications Board.

#### *Broadcast Operation Panel*

A panel on broadcast station operation during war time, organized by Lynne C. Smeby, discussed subjects such as priorities and procurement; fire fighting and property protection; telephone lines, battery operated equipment for emergency use; radio broadcast silencing systems; temporary and auxiliary antennas, and emergency equipment. Members of the panel included Frank Cowan, AT&T; J. D'Agostino, NBC; Raymond F. Guy, NBC; R. V. Howard, KSFO; William Lodge, CBS and Andrew D. Ring, consulting engineer. Frank Cowan of this group and transmission engineer for AT&T was instrumental in installing Interceptor Command Information Centers and special defense communication networks. Mr. Ring is secretary of the Domestic Broadcasting Committee of the DCB. Others either served on the DCB, or in a specialist capacity and thus provided invaluable statistics and corresponding data.

The application of broadcast facilities in time of emergency as exhibited by WHAS during the Ohio River flood which engulfed a large portion of the City of Louisville was the basis of a discussion by Orrin Towner, chief engineer of WHAS. Many experiences learned during this emergency as applicable to national defense were presented.

Increasing difficulty in obtaining re-

pair materials and changing of personnel due to induction into armed forces, aggravates the problem of proper transmitter maintenance under war time conditions. A round table discussion headed by Charles Singer of WOR, prominent exponent of organized transmitter maintenance, revealed many and unusual plans that will be placed into operation soon.

#### *Transcription Committee*

A Recording and Reproducing Standards Committee coordinated by the National Association of Broadcasters formed last June, have in part set up many important standards, that may now be adopted. Mr. Howard Chinn, of CBS, in charge of audio facilities and a member of the RRSC, discussed the standards and pointed out the modifications that must be made in existing equipment.

The problem of training of engineers and technicians for replacement and the assistance which broadcast station engineers can give in the training of technicians for the military services was covered in a round table discussion led by Professor W. L. Everitt, of Ohio University. The other members of the round table were C. M. Jansky, Jr., consulting engineer; Carl Smith, WHK, and G. F. Leydorff, WLW.

Other lecturers at the conference included J. H. De Witt, chief engineer of WSM, speaking on Studio-Transmitter-Links and High Frequency Antennas; Karl Troeglen, covering the subject of Engine Driven Emergency Power Plants; Daniel E. Noble, who spoke on Mobile F-M for Police; Gerald C. Gross, assistant chief engineer of the FCC, who related his recent experiences in England; Arthur Van Dyck, president of the IRE, who discussed the Alert Calling System, and Dr. Phillips Thomas, Westinghouse Electric & Mfg. Co.

The conference also served as the engineering convention of the NAB, complete program having been arranged, with the advice and assistance of Lynne C. Smeby, their director of engineering. This year, the Institute of Radio Engineers, was co-sponsor of the conference.

# NEWS BRIEFS

(Continued from page 23)

government duplicate copies of their drawings of the particular equipment being manufactured. These duplicate copies must take a definite form and must comply with definite specifications.

Many manufacturers are not familiar with these specifications. The Frederick Post Company, Box 803, Chicago, Ill., has developed a special process to supply originals required to meet the government specifications. This, it is said, eliminates the making of hand drawn tracings.

For information, specifically state whether the contracts you hold are for the Army, Navy, Air Corps or whatever other governmental department is involved. All requests for this information must be made on your letterhead and signed by an officer of your company.

\* \* \*

## RCA TO BUILD NEW TUBE PLANT

A new radio tube manufacturing plant at Lancaster, Pa., will be put up by the RCA Manufacturing Company soon.

Ground for the main building, which will occupy 326,000 square feet of space, will be broken around sometime in March, it is expected.

In 1941 RCA built over 400% more power tubes than in 1940, over 200% more cathode ray tubes, and over 300% more special purpose tubes. In these three categories shipments are running substantially above 70% for defense purposes. Based on present available estimates, demand in 1942 will be five to six times the value of RCA's 1941 shipments, which were 2½ times the 1940 total.

\* \* \*

## MYCALEX NEW PLANT IN OPERATION

A new Mycalex plant covering an area of over 55,000 square feet is now in operation. Mycalex, a patented combination of mica and electrical glass, is filling many needs today, in a variety of applications.

It is said to be free from any plastic yield at any temperature reached in practice, and possess low losses under the most severe conditions. According to Mycalex engineers this material can be cut, drilled, tapped, milled, ground and polished to exacting specifications.

A 12-page illustrated booklet with full descriptions of Mycalex uses in radio, telephony, railroading, mining, elevators, X-ray, aviation and other fields has just been published. Write to Mycalex Corporation of America, 7 E. 42 St., N. Y. City.

\* \* \*

## LEWIS, CBS VP, JOINS OFF

W. B. Lewis, vice-president in charge of broadcasts of the Columbia Broadcasting System, resigned recently to serve as assistant director of the Office of Facts and Figures, in charge of operations.

Douglas Coulter, who has been acting head of the department since Mr. Lewis went to Washington, will continue in that capacity.

\* \* \*

## NEW ASSISTANT CHIEF ENGINEER FOR HYGRADE

Walter L. Krah, formerly division engineer of the Salem, Mass. radio tube plant of Hygrade Sylvania, has been appointed assistant chief engineer.

In his new post, Krah will assist and advise Roger M. Wise, chief radio tube

Model 556A for  
35-50 ohms.  
Model 556B for  
200-250 ohms,  
and Model  
556C high im-  
pedance at  
only \$75.00 list

## A New Concept of Directional Performance



New "556" Super-Cardioid Dynamic Microphone offers further simplification of sound pick-up problems in studio and remote broadcasting.

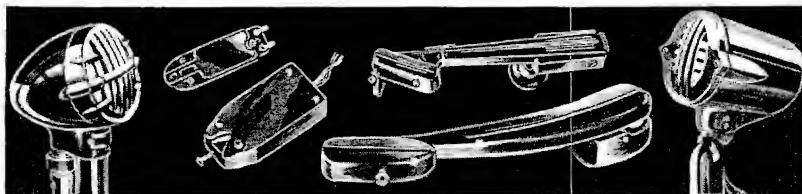
Super-Cardioid pattern achieves maximum unidirectional action over a wide frequency range — yet retains wide-angle front pick-up. Provides an easier means of eliminating undesired noises — gives full reproduction of music, clear reproduction of speech. Shure Uniphase\* single-unit moving-coil construction. Extremely rugged. Insures better performance outdoors as well as indoors — yet is surprisingly moderate in cost.

**30-day Free Trial.** Broadcast Engineers: Try the "Super-Cardioid" for 30-days in your station without obligation. Available for immediate delivery. Write us today.

\*Patented by  
Shure Brothers

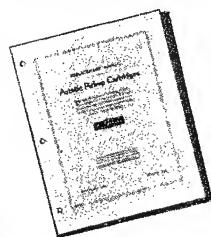
**SHURE**

**SHURE BROTHERS**  
Designers and Manufacturers of  
Microphones and Acoustic Devices  
225 West Huron St., Chicago



## ASTATIC PRODUCTS UNIVERSALLY USED

Convincing proof of the dependability of Astatic products is contained in Astatic's **REPLACEMENT MANUAL** for Pickup Cartridges, listing the various type cartridges used by a large majority of the manufacturers of radio phonograph combinations and playback equipment. This manual is a quick and valuable reference for Radio Jobbers, Dealers and Service Men who handle and service replacement parts.



To obtain your **FREE** copy of this handy Manual, see your Radio Parts Jobber.

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THE ASTATIC CORPORATION  
YOUNGSTOWN, OHIO

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**LAMINATIONS**

For Output Transformers of highest permeability

Standard Sizes for Audio, Choke, Output and Power Transformers in Stock.

Write for dimension sheets.

**PERMANENT MAGNETS**

Alnico (cast or sintered) Cobalt, Chrome or Tungsten, cast, formed or stamped. Engineering cooperation backed by 40 years experience insures quality, dependability and service.

**Thomas & Skinner**  
Steel Products Co.  
1113 E. 23rd St. Indianapolis, Ind.



### Polarized JEWEL PILOT LIGHT ASSEMBLY

Now, the brightness of illumination, or colored signal light intensity can be regulated instantly. For, a partial turn of the jewel dims or brightens the light intensity of our new No. 80 Type Assembly. Polarized discs, behind the jewel, arranged to be free to rotate with respect to each other, turn the trick!

Have you a copy of our catalog? It presents a complete line of standard and special Dial and Jewel Light Assemblies. We supply most of America's leading communications, aircraft and electrical manufacturers. You are assured of every possible cooperation in your needs.

**DRAKE MANUFACTURING CO.**  
1713 W. HUBBARD ST. • CHICAGO, U.S.A.

(Continued from page 25)

engineer and will direct activities of both Emporium and Salem engineering sections. His work embraces design and development, product engineering, engineering test and quality, commercial engineering, and standardizing.

\* \* \*

### G. E. APPOINTS C. G. FICK TO NEW POST

Clifford G. Fick has been appointed assistant designing engineer of the transmitter division of G. E. In January, 1927, Mr. Fick joined G. E. serving in the aircraft group, and as head of the low power and government section. He held the latter position until his recent appointment.

\* \* \*

### NEW HOLLYWOOD RADIO SHOP

Los Angeles Radio Co., has opened a shop in Hollywood at 1063 North Vine St. Managed by Ralph Oeffinger and Sidney Siegel the store will serve as a retail outlet for sets, recorders, discs and a service department.

\* \* \*

### KPRO USES PRESTO

KPRO, recently placed on the air in Riverside, California, has installed a complete dual turntable portable Presto recording installation for delayed broadcasts and other program use. Norman Dewes is chief engineer of the station.

\* \* \*

### GATES REMOTES FOR KFVD

KFVD has recently placed three Gates radio remote pickup units in service. These units, known as "Dynamotes" provide three position mixing, master gain, visual volume indicator and come complete with AC power supply in compact carrying cases.

\* \* \*

### GLASS AS INSULATING MATERIAL REVIEWED

The uses of glass as an insulating material are explained in a report recently made by E. B. Shand, entitled, "The Dielectric Strength of Glass—An Engineering Viewpoint."

The study is organized under three main headings: 1—Dielectric Failure of Glass; 2—Factors Governing Failure; 3—Curve Data. Tables and data curves include: Disruptive strength; Graphic representation of breakdown Characteristics; Selected dielectric breakdown data for glass; Selected breakdown data for porcelain; Oil Puncture tests on power insulators; Dielectric breakdown characteristics of "Pyrex" Glass and Porcelain.

Mr. Shand's study was recommended by the AIEE committee on basic sciences and was presented at a recent AIEE North Eastern District meeting at Rochester, New York.

\* \* \*

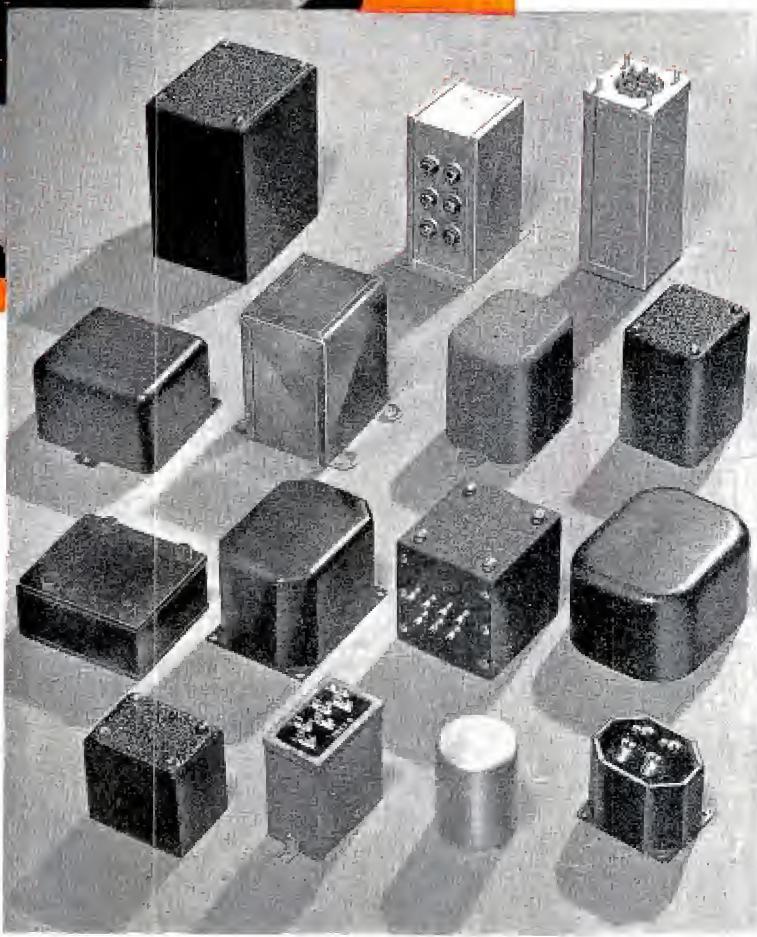
### CLAROSTAT POWER RHEOSTATS IN LARGE-SCALE PRODUCTION

An exclusive production department of power rheostats has been set up in the plant of Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y. For the present the efforts are concentrated on the 25-watt size, but a 50-watt size will soon be added to the line.



# TOUGH?

Not when  
**YOU'RE EQUIPPED  
TO HANDLE THEM**



In addition to the electrical characteristics, many customers' application problems are related to the physical appearance and dimensions of their transformer components. Fortunately, the UTC sheet metal division supplies practically all the housings, laminations, brackets, and other devices which control the mechanical characteristics of UTC units. Instead of restricting designs to specific cases, the sheet metal division can run off a special case to more closely fit the final transformer dimensions, or to effect the particular mounting provisions required by the application.

The sheet metal division has drawing, forming, and other press facilities to cover the entire gamut of transformer housings from tiny transformer channels, to large oil tanks for broadcast and industrial service. Since these housings are produced at UTC, fast service can be given.

*Illustrated are a few (just a very few) typical cases as supplied for some special applications*

**IF YOU HAVE A SPECIAL PROBLEM, MAY WE HAVE AN OPPORTUNITY TO COOPERATE?**

# UNITED TRANSFORMER CO.

150 VARICK STREET

★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"



## VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President

RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y.

GEORGE H. CLARK, Secretary

**I**N the recent election, the following officers and directors were chosen. William J. McGonigle, New York Telephone Company, president; A. J. Costigan, Radiomarine Corp. of America, vice-president; G. H. Clark, Radio Corp. of America, secretary; William C. Simon, Tropical Radio Telephone Co., treasurer; W. S. Wilson, 405 Delaware Avenue, Wilmington, Delaware, resident agent, with the following chosen to serve on the board of directors: George H. Clark, Radio Corp. of America; A. J. Costigan, Radiomarine Corp. of America; W. S. Fitzpatrick, Radiomarine Corp. of America; C. D. Guthrie, U. S. Maritime Commission; William J. McGonigle; Fred Muller, U. S. Navy; H. H. Parker, Westchester Lighting Co.; V. P. Villandre, Radiomarine Corp. of America.

### PRESIDENTIAL MEDAL

"Pioneer and Patron of Radio" is the inscription of V.W.O.A.'s proudest medal of all . . . that inscribed to the radio leadership of the President of our country. The word is not conventional: it is based on carefully considered facts, facts which go back to early days in radio history.

During the throes of World War I, radio was in somewhat the same position as aeronautics today. It had reached a turning point in its development, and was about to emerge from a relatively low-power, low-range status to a development suitable for international communication. The Navy's far-flung web linking America with the East was ready, ready on time, but the far more important tie between America and Europe had not yet been created.

Particularly was this true of reception in this country. Cursed with a ferocity of static unknown to European receiving stations, signals from England, France, Italy were smothered under a barrage of clicks and grinders from "south-south-west"—"hemispheric solidarity in matters radio not being in the picture! Weagant had already done yeoman work in pioneering static-reducing methods; Taylor, Alexanderson, Pickard and others followed soon after. But their best was not good enough to transform the accepted Navy receiving sites—Belmar, Tuckerton, Sayville, the Navy Department headquarters in Washington—for efficient twenty-four-hour daily service. It seemed that only a miracle could give America the desired linkage with its Allies.

The miracle happened! An eager, clear-minded young radio amateur, Alessandro Fabbri, had long operated his private station at Bar Harbor; had found it to be of exceptional character, especially in receiving and wished to donate it to the service of the country. Radio engineers confirmed his statements; all that remained was an organized setup. But in the maze of things being done, then as now, without regard to time, it seemed as if the offer and the crying need for the station had been forgotten.

Then it was that the Assistant Secretary of the Navy, Franklin D. Roosevelt, stepped into the picture. With ruthless disregard of red tape he conferred with civilian donors and official acceptors, and finally through his efforts Alessandro Fabbri was enrolled as Ensign in the United States Naval Reserve Force. Overcome with gratitude, he hastened to the Assistant Secretary's office, and—as his diary puts it—"was immediately admitted to his office, found him weary but sympathetic, and courteous, as always". With a new sense of strength Ensign Fabbri left or Bar Harbor.

But his troubles were not over. Soon thereafter the Assistant Secretary of the Navy paid a flying visit to the Bar Harbor site, and when he heard that the official acceptance of the station had not yet taken place, he at once telegraphed Washington that he had personally authorized this acceptance on the spot. The Naval Radio Receiving Station at Otter Cliffs, Bar Harbor, Maine, was born!

Well did its efforts justify the pain of its creation. Almost from the first, it proved to be a site where signals from Europe were of exceptional strength, static from Central America of less hampering force than at any other known point in the United States. Better still, the great circle bearings of the wanted and unwanted signals were in the same line, and hence the directional-antenna method or reducing static disturbances could be utilized to greatest value.

Installation and development proceeded with utmost speed, once the site had been

authorized. A relatively simple method of static reduction, simple as to circuits and requirements of area, and simple of operation by the everyday operator, was developed and installed by G. W. Pickard and J. A. Proctor of the Wireless Speciality Apparatus Company. In a very short time the Otter Cliffs station assumed the duty of receiving the entire bulk of European radio signals for the Navy. Thus it was that our President-to-be acted in a pioneer capacity in matters radio: he cleared the way, so that the station might later clear the air.

Pioneering in still another capacity, Assistant Secretary of the Navy Roosevelt was one of the principals in the first duplex radiotelephone communication, held on May 5, 1919, between the Navy Department and the U.S.S. George Washington, the latter about 200 miles from New York. Secretary of War Baker on the ship spoke with Mr. Roosevelt in Washington, and official business was transacted. Again, on a succeeding voyage of this vessel, President Wilson on July 7 spoke at sea to his Assistant Naval Secretary in Washington. These were pioneer events.

Many instances occurred during the period when the writer was technical assistant to the officers in charge of radio development and installation for the U. S. Navy wherein these officers took to the Assistant Secretary problems of cutting red tape and speeding production thereby. In every case the common sense side of the argument was accepted by him. In one particular instance, involving the

(Continued on page 29)



The committee at presentation of the Presidential medal—left to right, front row—Neville Miller, Admiral Noys, James L. Fly, General Olmstead, George W. Bailey. Left to right, back row—W. D. Terrell, F. P. Guthrie, Commander Webster and E. H. Rietzke.

## THE INDUSTRY OFFERS....

### LUMINOUS DIALS

Dials, particularly adaptable for aircraft, molded by "Three Dimensional" process with luminous characters are now being made by the Plastics Division of Erie Resistor Corp., Erie, Penna. In this process, the article is first molded of clear plastics with the lettering and characters indented in the rear surface. The characters are then coated with a specially developed fluorescent material that glows when exposed to invisible ultra-violet light, popularly known as "Black Light." The entire rear surface is then painted with a special material developed by Erie Resistor. This paint, although not black in color, will it is said, not reflect light, and thus makes the markings easier to see in the daytime. The face of the dials are also processed to obtain an etched, non-reflecting surface.

An advantage of these dials it is said, is the longer life of the luminous paint. This is due to the fact that it is applied on the rear surface, and the front of the articles are entirely smooth. Thus, both the luminous material and the background paint are not subjected to any surface wear. When these parts were made of metal, the paint had to be applied to the top surface where it came in direct contact with the hands when turning the knobs.

The angles of the characters are such that they can readily be removed from the mold and are so designed that they can be clearly seen when viewed from an oblique angle by the pilot.

The design and production details of these dials were developed jointly by the engineering departments of Curtiss-Wright and Erie Resistor.

\* \* \*

### FIBRONIZED KOROSEAL TUBING

A new insulation, Fibronized Koroseal Tubing, has been developed by Irvington's Fibron Division from Koroseal, a product of the B. F. Goodrich Company.

The advantages of Fibronized Koroseal are said to be inside and outside smoothness, exceptional elasticity and close manufacturing tolerances; excellent resistance to acids, alkalis, solvents and heat; fire-proof with an insulation resistance of infinity after 16 hours at 90% R.H. and 105° F.

The material is said to have a tensile strength of 2,845 pounds per square inch, a dry dielectric strength (.022" wall thickness) of 1,050 VPM, a wet dielectric strength (.022" wall thickness) of 817 VPM after 24 hours immersion.

\* \* \*

### NEW ELAPSED TIME METER

For making life tests on radio transmitters, tubes and beacons, a new meter to indicate elapsed time in minutes or hours has been developed by Westinghouse Electric and Manufacturing Company.

Using six counter units instead of the usual five, the meter consists essentially of a synchronous driving motor, a gear train and six numbered wheels. The motor operates at 600 rpm on a 115 volt, 60 cycle circuit. Synchronous operation is not affected by voltage variations of from 75 to 125 per cent of rated value. Life time bearing lubrication is provided by an oil storage reservoir. Gears are precision, ma-

(Continued on page 33)

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### VWOA NEWS

(Continued from page 28)

procurement of a large number of receivers by allocation at a price determined by the radio officer as fair, instead of by the hide-bound method of advertising and acceptance of lowest bid, the former plan was approved when laid in the Assistant Secretary's lap, and as a result the Navy was fully equipped with receiving equipment before war came.

Such the pioneer days. Today, when world communication is one of the essentials of modern life and especially of modern war organization, our President almost literally lives with radio circuits by his side the day long. The radio-telephone

to him today is not an experiment, but an hourly necessity, and decisions involving our life and our future are made by virtue of it functioning. Pioneer in the war that is past, hourly patron in the war of today, the President of our United States of America is most truly a "radio executive."

G.H.C.

### HATS OFF TO McELROY

Leaving school in the 9th grade Ted McElroy became messenger boy for Western Union at the age of fourteen. A substitute operator at fifteen, he was transferred to the New York office of Western Union working cable circuits using American Morse.

Today, Ted is successfully engaged in making automatic transmitting code units.



## MONITORING

*For efficiency,  
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● DuMont Type 213-A Cathode-Ray Modulation Monitor is a "must" piece of equipment in safeguarding today's high broadcasting standards. Permits monitoring and study of radio-frequency transmissions, while eliminating necessity for connecting deflection plates of cathode ray tube to bulky externally-provided tuned circuits. In other words, it is entirely self-contained with its own resonant circuit tuned to transmitter frequency and coupled by means of low-impedance link to source of modulated radio frequency.

Modulated envelope or trapezoidal modulation patterns. Tuned circuit frequency range of from 400 kc to beyond 40 mc per second. Horizontal deflection effected either by internally provided linear sweep circuit for modulated envelope type of study, or by audio-frequency voltage taken from transmitter modulator circuit.

This instrument is typical of DuMont cathode-ray oscilloscopes available for any laboratory, production, station or field requirements.

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## THE F-M TESTS

(Continued from page 7)

and a-m. The observers in the car listening to the desired Schenectady a-m signal all agreed that this difference need not be given further consideration.

There was no appreciable interference from either f-m or a-m on the second adjacent channel (80 kc from the desired signal) when this test was made.

After this conclusive demonstration the FCC indicated it would accept and act favorably on construction permit applications for the use of frequency modulation by police, utilities and others. The first few licenses granted were issued as Class 2 experimental stations, but in the fall of 1941 all f-m stations were licensed in the regular manner.

The commercial apparatus that was then developed by G. E. has been furnished to over a hundred police and utility users. The same type of apparatus is now being furnished to many branches of the U. S. Government.

Besides the overwhelming superiority of f-m over a-m in performance, the actual commercial apparatus has many other advantages. Before f-m, 15-watt a-m mobile transmitters were the general standard, as the power input required for 15-watts a-m 100 per cent modulated used about the limit of power that could be taken from the standard heavy-duty car battery. The present f-m mobile transmitter draws less current, uses fewer tubes than its 15-watt a-m predecessor, and produces more than twice as much carrier output. Also, a complete set of tubes cost just one-half as much for this 30-watt f-m transmitter as for the 15-watt a-m unit. Even a 60-watt f-m mobile transmitter uses only 10 per cent more current than the previous 15-watt a-m transmitter.

Emergency f-m transmitters are directly crystal controlled, using phase modulation. Saturation of the grids in

the following stages eliminates the small amount of amplitude modulation produced and frequency modulation only is left in the output stage. The crystal operates at  $\frac{1}{3}$  of the output frequency and modulation takes place in the output circuit of the crystal oscillator, and the subsequent amplifier stages are all operated Class C telegraph rating. The complete transmitter is smaller and weighs less than the corresponding a-m unit.

The receivers now in production provide a readable signal with less than one-half microvolt input to the receiver. Measured noise reduction using a calibrated signal-generator input, indicates approximately 20 db noise reduction with 0.4 microvolt input to the antenna circuit. This represents real performance when one considers the much higher signal inputs required of a-m receivers to over-ride the noise and produce a readable signal.

The "squelch" action or carrier-off noise suppression is also a new outstanding f-m development. Since the receivers would operate satisfactorily on such low signal strengths, the type of squelch circuit used on a-m receivers could not be used, since they were sensitive to a-m noise. For f-m, a new circuit had to be developed and made to operate on a continuous carrier, while remaining closed, regardless of peak value of random noise. In its present state of design, this circuit can be adjusted to as low a value as 0.1 microvolt and open when an f-m carrier equal to 0.1 microvolt or greater comes on, but it will not open in the absence of a carrier under any random noise condition.

Undoubtedly new and interesting developments will take place in the f-m field, just as they have in a-m. This new tool of the radio engineer should lead to ever-increasing usage of radio communication.

## EMPIRICAL EQUATIONS

(Continued from page 11)

60, 300 a graph such as shown in Figure 6, should be drawn with the result that  $n = .632$  would probably be chosen, yielding equation  $y = 22.6 x^{.632}$ . The values are shown in Figure 2.

In plotting Figure 6 various y values of the two extreme points from Figure 2 were plotted to correspond to several different combinations of n and a. Then

an average was taken between the values of n that permitted the upper and lower points to correspond to the experimental values, and this value of n and the related value of a were used to determine the equation given above. The procedure may be used to cause the curve to pass through any two points desired.

As a third example, let us take the

general parabolic equation  $y = ax^2 + bx + c$  that will often apply where none of the two constant laws will hold. If the successive values of  $x$  have a constant difference, the general parabolic law will hold if  $x$  and  $\Delta y$  follow a straightline relation. However, the method described here will work even though the successive values of  $x$  do not have a common difference.

Consider the set of values given in Figure 3. Figure 7 shows  $x$  plotted against  $\Delta y$  to give an approximate straight line. By examining the values of  $\Delta^2 y$  and finding that they are approximately constant, the proposition that  $\Delta y$  have constant differences is fulfilled. The chart also contains a list of  $x^2$  values to facilitate the forming of simultaneous equations.

Forming three pairs of simultaneous equations, we have

$$15 = 25a + 5b + c$$

$$18 = 100a + 10b + c$$

$$21.5 = 225a + 15b + c$$

$$25.5 = 400a + 20b + c$$

$$29.9 = 625a + 25b + c$$

$$34.8 = 900a + 30b + c$$

Adding the two equations in each group gives

$$33 = 125a + 15b + 2c$$

$$47 = 625a + 35b + 2c$$

$$64.7 = 1525a + 55b + 2c$$

Solving these simultaneously by determinants, we find that  $a = .00924$ ,  $b = .468$ , and  $c = 12.411$ . This gives the equation

$$y = .00924x^2 + .428x + 12.411$$

The values of  $y$  as determined by this equation are shown in column 6 of Figure 3, and it can be seen from examination of the error column that the maximum departure from the experimental values is of the order of 0.149. The sum of the positive errors is equal to .047, and the sum of the negative errors is equal to -.056, indicating a satisfactory balance.

## LINT AND TUBE NOISES

W. H. Krah of Hygrade recently pointed out that lint is still the major source of noisy tubes in spite of considerable progress made to eliminate it. Noise tests are not entirely reliable primarily because of the possibility of loose conductive particles shifting from positions where they can not cause noise during one test to position where they can cause noise prior to another test.

Radio frequency disturbances resulting from intermittent contact between conductors are the fundamental source of sharp impulse tube noises.



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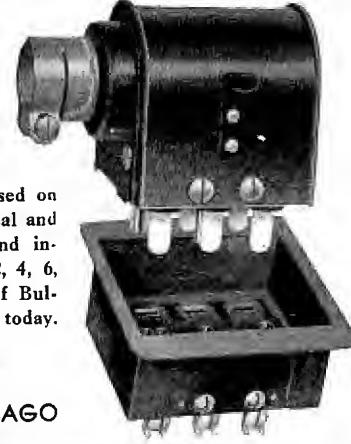
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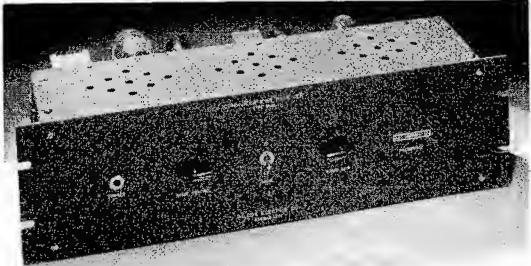
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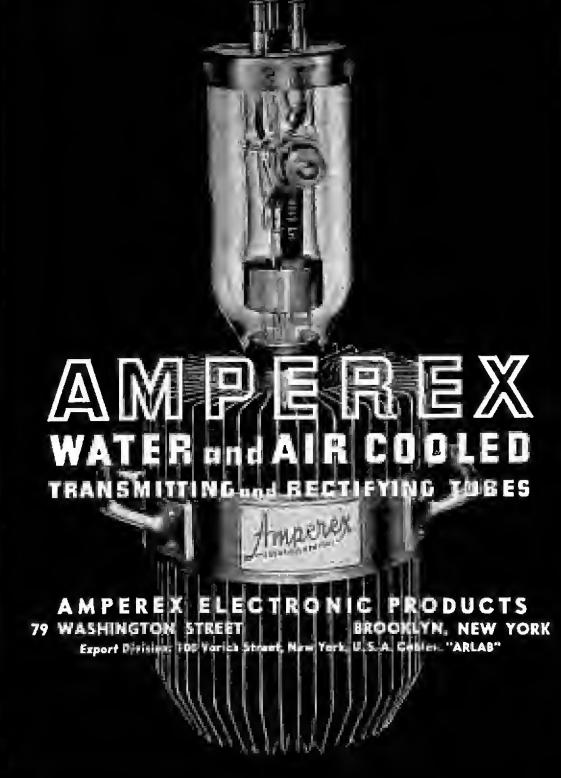
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## CIVILIAN EMERGENCY NETWORKS

*(Continued from page 20)*

cumstances and the plan of operation for the individual net. For "walkie-talkie" service the choice is usually limited and here the J type has advantages over the usual, single vertical rods, for reasons previously mentioned. For mobile or portable car operation some prefer antennas mounted directly on the car. Here again the J has some advantage, particularly if mounted high enough to lift the radiator above the car body.

Other operators are coming to prefer portable-car rather than mobile operation, with antennas mounted on 12 or 14 foot poles which may be slung under the car in transit and mounted by means of supporting brackets on the car bumper or by leaning against any handy support when operating. This permits operation only when the car is standing still (as indicated by the designation "portable-car operation") but the added elevation thus gained can make a tremendous difference in the value of the radiated signal. Moreover, this form of mounting lends itself to more efficient

antenna types, such as the coaxial half-wave, the double extended Zepp, etc. That the idea has merit is indicated by the swing of many oldtime mobile operation enthusiasts in this direction. Bamboo or 2" x 2" white pine are conveniently light and should be well varnished if they are to ride beneath the car. The antenna is, of course, permanently mounted on the pole, terminating in standoff screws or jacks to which feeders can be quickly connected for operation. There is no law against also including an antenna on the car itself if operation during transit is deemed necessary, with provision for quickly switching antenna connections of the rig from one antenna to the other.

### Communications Men Essential

Communications men and hams are going to be in an enviable position to render an extremely important service to their local communities when Washington again starts issuing operating

authorizations, and it appears quite likely that a start will be made within the next thirty days. Unless previous rules are altered, such authorizations will be issued only to licensed amateurs or those who can qualify for such licenses, examinations for which will, it is understood, be continued.

In some cases local defense officials may not be sufficiently familiar with the possibilities of this service to take the initiative in forming communications units; or they may not realize that there are qualified men in their communities. It is therefore by all means desirable that every amateur make his presence known to his local officials and offer his full cooperation. There are also opportunities for *communication men* who are not amateurs. There is organization and coordination work to be done, much of which is quite within the realm of those who are familiar with the various branches of communications, even though they may not be qualified to actual operate emergency defense equipment.

## THE INDUSTRY OFFERS....

(Continued from page 29)

chine cut and gold plated to resist corrosion.

To operate, the meter is connected in parallel with the apparatus of which total hours of operation are to be measured. Meter circuits are closed when the machine operates, causing the synchronous motor to run continuously.

Resetting to zero or any value is accomplished by removing the case and disengaging the number wheel shaft. The wheels can then be set to any desired reading.

\* \* \*

### ERRATUM

The illustration used in the description of the IRC Low Power Concentric Transmission Line Terminations in January, 1942, COMMUNICATIONS actually showed IRC Sealed Voltmeter Multiplier Resistors. These sealed resistors have been designed to operate under severe humid conditions, and are hermetically sealed and encased in a glazed ceramic tube.

\* \* \*

### SPEAK-O-PHONE RECORDER

A new unit consisting of an amplifier, speaker, microphone, desk type stand, motor, turn table and gearing mechanism are included in the latest development of the Speakophone Recording and Equipment

Co., 23 W. 60th St., New York City.

The amplifier has three stages of amplification using 7F7-6V6-5Y3 tubes. Frequency range is up to 6,000 cps. Power output is 5 watts. Frequency compensation is provided for slow speed operation. The dual speed enables one to record up to 24 minutes on a 10" record. Plays all records up to 12".

A crystal microphone, cutter head and pick-up is used.

Known as the Model 88C recorder, playback and public address unit, it is housed in a carrying case, size 16 x 16 x 10".

\* \* \*

### LIMIT BRIDGE

The Shallex Mfg. Co., Collingdale, Pa., has designed and is now offering a highly specialized Limit Bridge for rapid and accurate testing of multitapped resistances with varying unit values.

This special Bridge No. 618 has binding posts for connecting a galvanometer and battery, with special mercury wells providing a method for attaching a multi-tap resistance resistor. A rotary switch selects the unit of the multi-tap to be tested and at the same time places the proper standard in circuit. A suitable key switch tests the tap for high and low tolerance.

\* \* \*

### LATEST HARVEY MOBILE UNIT

A new transmitter, the 100XE, nominally rated at 100 watts of carrier output on phone and CW and intended to furnish communication between boats, other field units, district headquarters, and division offices, has been developed by Harvey Radio Labs., Inc., 447 Concord Ave., Cambridge, Mass.

Its frequency range is 2,000 to 6,400 kc. The antenna tuning equipment in the transmitter will allow proper adjustment to an antenna or transmission line, whose impedance is purely resistive and is of the order of 73 ohms.

A crystal oscillator is used in this unit. As the plate tuning condenser is tuned to resonance a small portion of the radio frequency energy is fed back to the quartz plate which is excited by this feedback voltage. Due to the low grid to plate capacity in the 807 oscillator tube a small amount of external grid to plate capacitance has been added to obtain improved stability of crystal control operation.

The power amplifier utilizes a single 813. Fixed bias voltage is used on this stage. In this way the oscillator can be keyed without damaging the 813 tube in the final. With the key in the open position the fixed

(Continued on page 34)

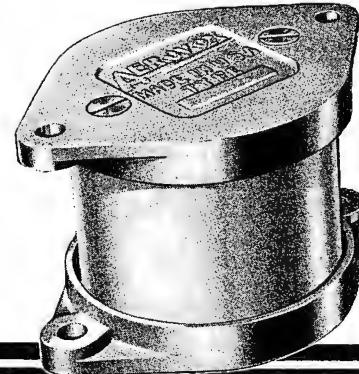


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Type 1960: 4 1/4" dia. x 3" tall. .00001 mfd. 15,000 v. to .25 mfd. 1,000 v.  
Type 1970: 5 3/4" dia. x 4" tall. .00001 mfd. 20,000 v. to .5 mfd. 1,000 v.  
Type 1980: 5 3/4" dia. x 5 3/4" tall. .00001 mfd. 35,000 v. to .05 mfd. 5,000 v.

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(Continued from page 33)

bias to the final will reduce the plate current to zero. Antenna matching network is arranged in the form of a Pi filter. The combination antenna matching and power amplifier resonant tank circuit results in high transfer efficiency, high harmonic reduction (fundamental to harmonic power ratio of a million to one is said to be obtained), and ease of tuning due to the small relative number of tuning controls.

Modulation is accomplished by varying simultaneously the screen grid and plate voltage of the 813 final amplifier tube. A dropping resistor is used in the screen circuit instead of the usual screen winding on the class B modulator output transformer. This is entirely permissible since the power loss in this case amounts to only a few watts. Audio frequency voltage is applied to the plate of the 813 tube and also to the screen through the screen dropping resistor. Class B modulators are used because of their high efficiency, low harmonic output, and low operating cost.

Due to their low harmonic content and low plate resistance 2A3 drivers operating in Class AB are used.

Since the carbon microphone operates at a power level of approximately -15 db, a low gain amplifier is all that is necessary to properly drive the 2A3 drivers. This is accomplished by using a low gain input stage (6C5) which amplifies the approximate one volt developed by the carbon microphone to 10 volts. This results in approximately 30 volts drive to the grids of the 2A3's which is sufficient to properly operate the 838 modulator tubes.

Only one method of keying the transmitter is provided. This consists of removing the screen voltage from the 807 oscillator and applying approximately 100 negative volts when the key is in the open position. Closing the key puts a positive voltage on the screen which causes the tube to oscillate and to deliver power to the grid of the final amplifier. The final is biased to cut-off so that when the key is opened no plate current will flow.

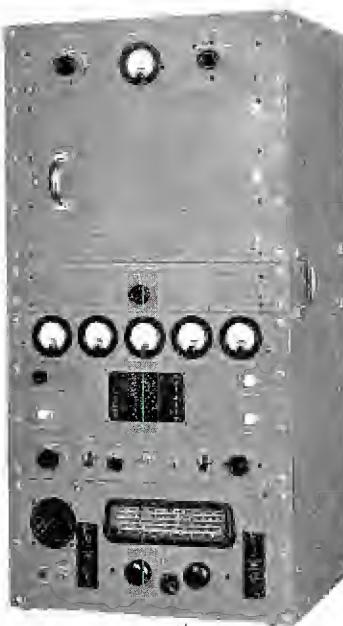
The main power supply for the transmitter is obtained from a pair of 866A's operating in a full-wave circuit. The bias and low voltage supply also has a full wave rectifier using 866A's. Both supplies have choke input and output smoothing. Due to the design less than 1% ripple content is in the output of the supply. The choke input feature also results in long rectifier tube life because of the de-

creased peak voltage.

In order to save wear and tear on the large primary relays a separate complete power supply utilizing a dry disk type rectifier and choke input filter is used to supply power to the keying relays.

salt-spray test requirement. Covers are available to protect the units from dust and dirt.

Blue prints showing dimensions of the ordnance types as well as IRC, Rheostat Data Bulletins Nos. VI and VI-a describing the standard types will gladly be sent upon request.



\* \* \*  
**SHATTER-PROOF IRC ALL-METAL RHEOSTATS**

A new type of IRC all-metal rheostats for aircraft and ordnance use where durability to withstand bomb and gunfire concussions, as well as dependability to meet conditions of high humidity and other temperature extremes are prime essentials, has been announced by the International Resistance Company, 401 N. Broad St., Philadelphia, Pa.

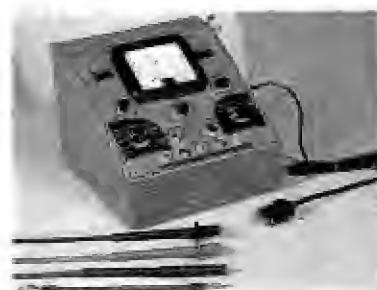
Instead of ceramic insulators which might shatter under concussions, the new ordnance type units have bakelite insulators. In addition to being lighter in weight than conventional rheostats, the IRC all metal rheostats are said to have a 50% lower temperature rise for equal size in other types. They are available in both 25- and 50-watt sizes to meet the 200-hour



\* \* \*

**NEW RCP ELECTRONIC MULTITESTER**

An electronically operated, multi-purpose meter instrument has just been announced by Radio City Products Co., 88 Park Place, New York City. Known as the RCP "Electronic Multitester," Model 662, it provides a total of 27 measurement ranges to take care of voltages, both a-c and d-c, up to 6,000 volts; resistance to 1,000 megohms; capacities to 2,000 microfarads. The low ranges for each of these types of measurement are such that values as low as 0.1 volt, d-c, 1.0 volts a-c, 0.2 ohms and 30 micro-microfarads can be read, it is said directly from the meter scale without interpolation or estimating fractional scale divisions. Any one of the 27 ranges is selected by means of two rotary switches, one of which selects the type of measurement desired, the other the numerical range.



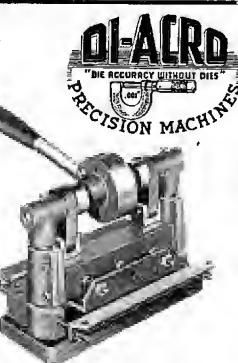
**Avoid Die Expense**

and time delay in making a great variety of parts or pieces with DI-ACRO Bender, Brake, Shear — "Metal Duplicating Without Dies." For instance the

**DI-ACRO SHEAR NO. 1**

Trims or squares duplicated stampings, cuts strips, makes slits or notches. Shearing width 6". All DI-ACRO Machines are accurate to .001".

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**CANNON SOUND PLUGS AND RECEPTACLES**

**NOW STOCKED IN NEW YORK**—The Cannon Electric Development Co. of Los Angeles has appointed us as distributors of their sound plugs and receptacles. Here is more evidence of Terminal's regular and reliable delivery of essential materials in the face of trying conditions.

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Sales Division—205 W. Wacker Drive, Chicago  
Factory—2035 Charleston Street, Chicago, Ill.

## We See . . .

(Continued from page 2)

way towards completion of these new plans.

To understand and appreciate the trend of metals and materials, it is imperative that daily reports, either in the press or association bulletins, be studied with care. Prudent analysis will provide an accurate scope of just where the situation stands. I say "prudent analysis," for today we are prone to rush through these data, accept hysterical headlines in many instances as the crux of the story and let matters stand. The appearance of these misinterpreted facts is not due to negligence or insincerity, but rather to the vague knowledge of the industry and its problems at the command of some of the reporters and those making the assignments. This situation has become a serious hazard and correspondingly steps are being taken to make suitable adjustments. Notwithstanding, an effective understanding of the problem by the engineer or executive will serve to provide a true picture, regardless of the distortion displayed in the dispatch.

There is no doubt that we are now going through some violent and sweeping industrial changes, with many more to come. It will not be a simple matter to adjust ourselves to this new way of operation, but it will have to be done. We might as well face the facts, accustom ourselves and institute all our new plans with care, precision and clear thinking, and not the haphazard way the enemy wants us to. It's the only way to succeed NOW.

ANOTHER MEMBER OF THE 20 YEAR broadcasting club is WOR, a notable event that was celebrated on February 22d. Progress certainly receives a high order priority rating in the advancements made by WOR. Starting with the 'high power of the day—250 watts', today they are among the nation's powerful network station with 50,000 watts on a-m and 10,000 watts on f-m. To the capable engineering-operating staff headed by Jack Popple and to the executive staff headed by Alfred McCosker, Julius Seebach and Theodore Streibert, our warmest congratulations for a grand job!

OUR HATS OFF to James S. Knowlson, who is doing such splendid work in the War Production Board, as Director of Industry Operations. It is gratifying to know that a radio man was chosen for this all-important post, and that his outstanding work now more than attests to the soundness of that choice.—L. W.

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—whether your job today may be in the armed forces or in industry!

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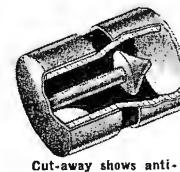
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## Midget Mercury Switch



Has wide and increasing range of use: For auto glove and trunk compartments, thermostat circuits, refrigerators, radio door lights, sliding panel light, indicator circuits, safes, etc.

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For circuits to 25 volts AC or DC, non-inductive, and currents up to 6 amps. at 6 volts, and 1 1/2 amps. at 25 volts. Whatever your application write us. Can be designed in several different types. Let us show you how it fits.

No. 1303—High Voltage Fuse Mounting

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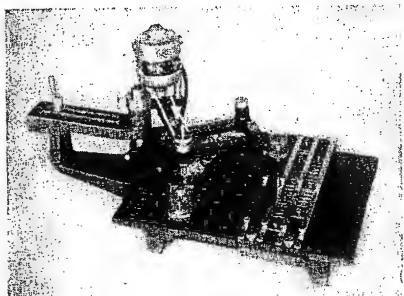
## DEFENSE Demands Premax Antennas

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## CRAFTSMEN . . . 1942 STYLE

**B**ELYING the popular conception of a craftsman . . . a long-bearded gent whose great-grandfather also made fine watches . . . is the modern shop worker whose mechanical skill equals, and often exceeds, that of the Old World mechanic. Even in this modern age of mass production there is more fine craftsmanship shown than the Old World ever dreamed possible.

General Radio, in the manufacture of precision electrical measuring apparatus, has its share of craftsmen whose fine mechanical skill is of the highest order. Take P. A. Sharpe, for example. He came to General Radio in 1924 to assemble intermediate-frequency transformers. Then in 1926 he graduated to the assembly of broadcast-receiver variable condensers. After a brief session with hot-wire meters, thermocouples and string oscillographs . . . all with enough delicate parts to try the patience of a saint . . . Sharpe returned to condenser manufacture.

Since 1930 Sharpe has devoted his entire time to the manufacture of precision condensers, both the stock laboratory type and the even more precise "bath-tub" models used in commercial and governmental frequency meters and similar precision equipment.

If there is doubt that true craftsmanship is required to assemble one of these precision condensers, you should drop in on Sharpe late some afternoon and watch him struggle with a row of condensers in the making, particularly on one of those days when nothing will seem to go together properly. The mechanical tolerances allowed for the numerous parts of a G-R precision condenser are so small that many times it is a feat even to assemble a group of these condensers!

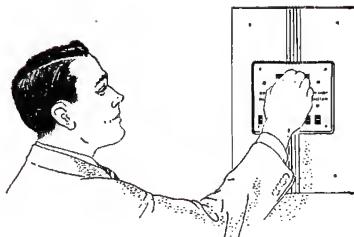
Percy Sharpe is typical of the large majority of General Radio men, most of whom have been working for some years on only a few instruments. In the interest of quality G-R has limited its production to small lots so that each man will concentrate on one or two instruments at a time. As a result G-R workmen know how to assemble G-R equipment rapidly and accurately no matter how complex the job is. In the assembly department G-R has never employed inexperienced and unskilled workmen.

All G-R apparatus is put together by men like Percy Sharpe, men who have been with the company for years and who will continue to show expert craftsmanship on G-R equipment for years to come.

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WHAT FORCE IS AVAILABLE TO OPERATE, CLOSE AND HOLD THE CONTACTS?

WHAT OPERATING LIFE IS EXPECTED?

WHAT IS THE ACTION OF CONTACT . . . SPST, BIPOLAR, ROTARY?

WHAT IS THE FREQUENCY OF ELECTRICAL INTERRUPTIONS?

DOES THE PRODUCT HAVE TO PASS UNDERWRITERS LABORATORIES TESTS?

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